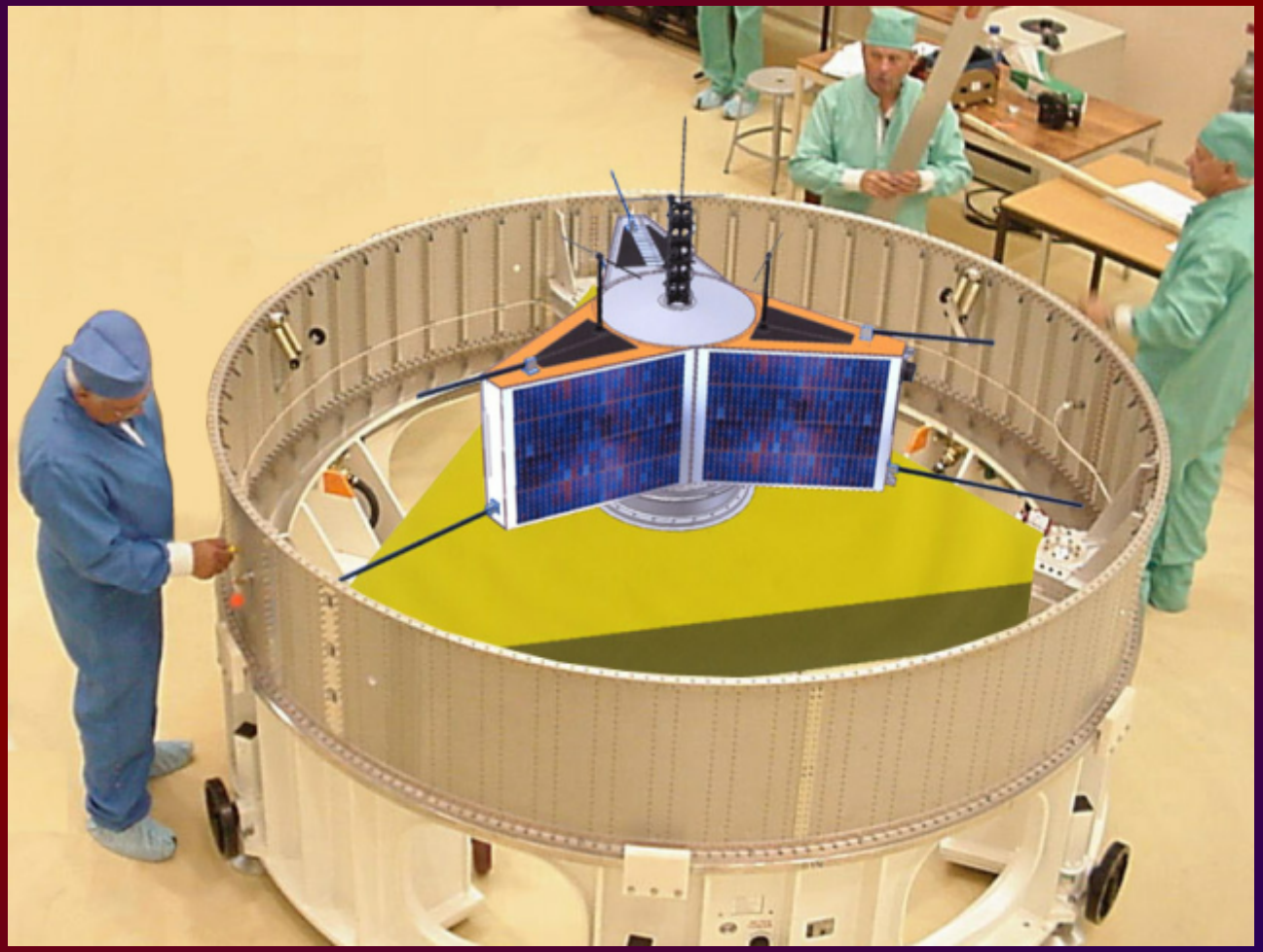
AMSAT P3-E (Phase 3 Express)



AMSAT P3-E (Phase 3 Express)

Objectives

- - providing communication performance to amateur radio to fill the gap created by the problems in AO-40 (P3-D).
- - to test and qualify advanced hardware for P5-A and other AMSAT spacecrafts.

AMSAT P3-E (Phase 3 Express)

Goal

- - to get a high-performance P3-E into orbit
- - with minimum cost
- - shortest time possible

AMSAT P3-E (Phase 3 Express)

Approach

- - Use as much as possible of existing hardware and technology available
- - Avoid new developments and qualifications as much as possible
- - Use a configuration that does not need other suppliers

AMSAT P3-E (Phase 3 Express)

Solution

- - Use the existing flight-worthy P3-structure (P3-C flight spare in Marburg)
- - Use the existing 19“ flight adaptor
- - Use a SBS as the basic launch interface
- - Use a simple triangular mounting table inside the SBS

AMSAT P3-E (Phase 3 Express)

Properties of the P3-Express Configuration

PROS

- - powerfull high-performance satellite concept („old P3-A/B/C) ---» no qualification
- - Use of SBS structure ---» no qualification
- - Resources exist to do the project
  - Ready for launch in late 2005
- - flight timing compatible with P5-A requirements

AMSAT P3-E (Phase 3 Express)

CONS

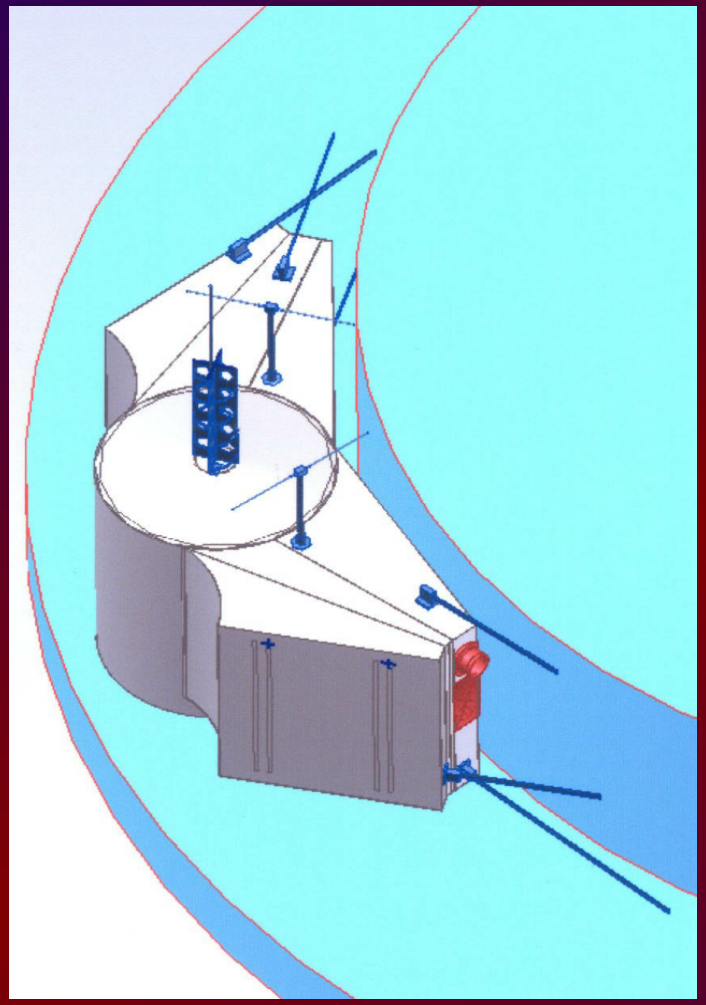
- - mass-wise not efficient
- - big size of flight structure

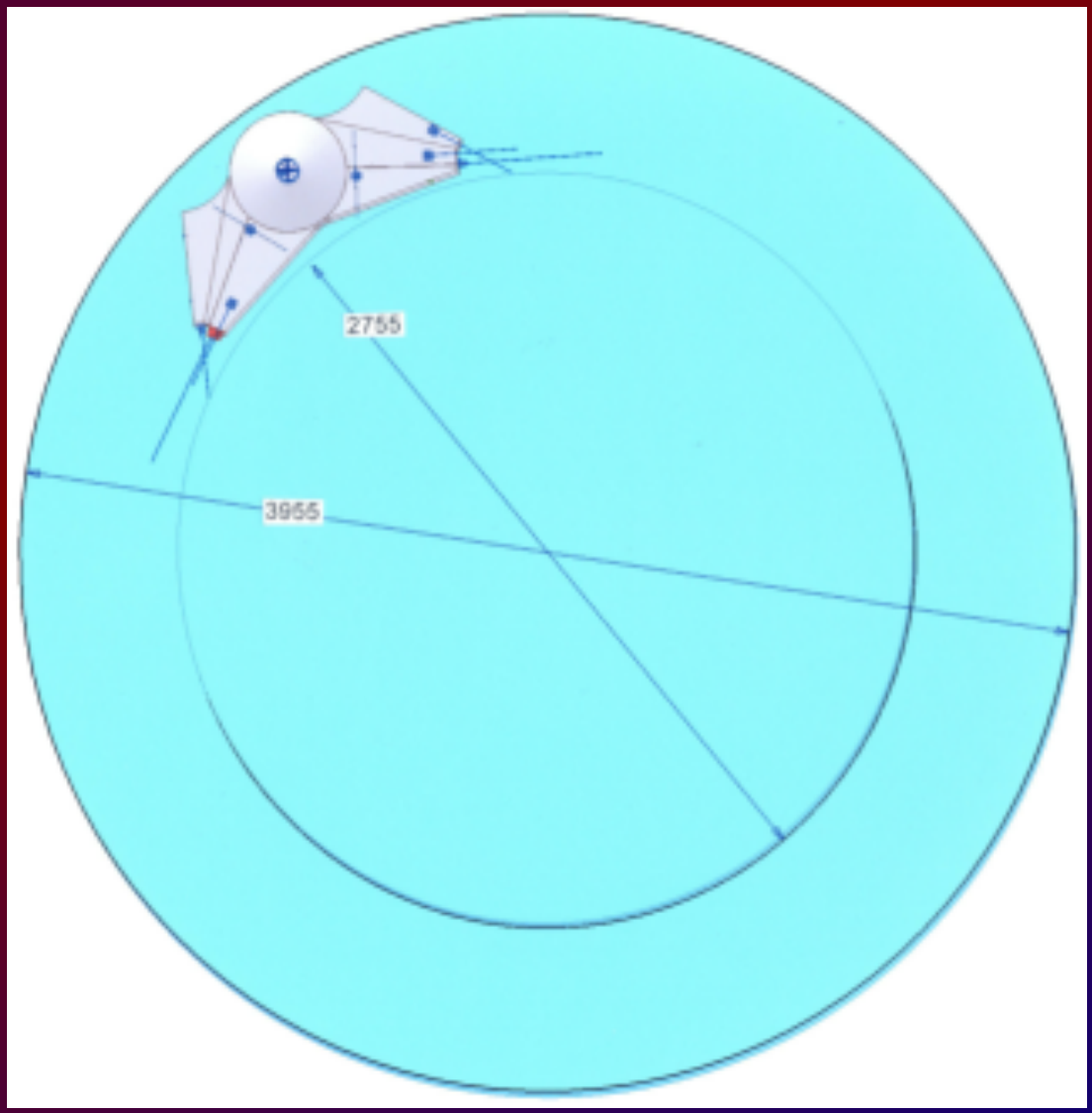
AMSAT P3-E (Phase 3 Express)

Conclusion

- **P3-Express presents the shortest path to get a high-performance spacecraft into orbit using only accessible resources!!!**

Ideas for ASAP5





P3-Express
to launch in the SBS

P3-E kick-off in 2001

AMSAT P3-E (Phase 3 Express)

Basic data

Total mass at lift-off ..... 150 kg
Satellite mass in orbit ..... 90 kg
Dimensions ..... Height 50cm / Span 1.30m
Spin stabilized ..... 20 – 40 rpm
Propulsion ..... 220 N engine (Astrium Space)
Propellant ..... 25.8 liter MON, 24.7 liter MMH
pressurized by Helium bottle, 2 liter He at 400 bar
Orbit ..... HEO, 1500km perigee, 36000km apogee, 57° Incl.
Launcher ..... ARIANE-5, Guyana Space Center, Kourou

Power Subsystem

BCR specification similar to P3-A, P3-B and P3-C:

Input current of generator: ..... ≤ 2.7Ampere, P_{max} 92W
Input voltage nominal: ..... 34.32 Volt
Input voltage maximum: ..... 45 Volt

Battery voltage: ..... 14.2 Volt (range 10.36V to 15,46V, 20mV/step)
Solar Generator voltage: ..... 32 Volt (range 19.2V to 44.7V, 100mV/step)

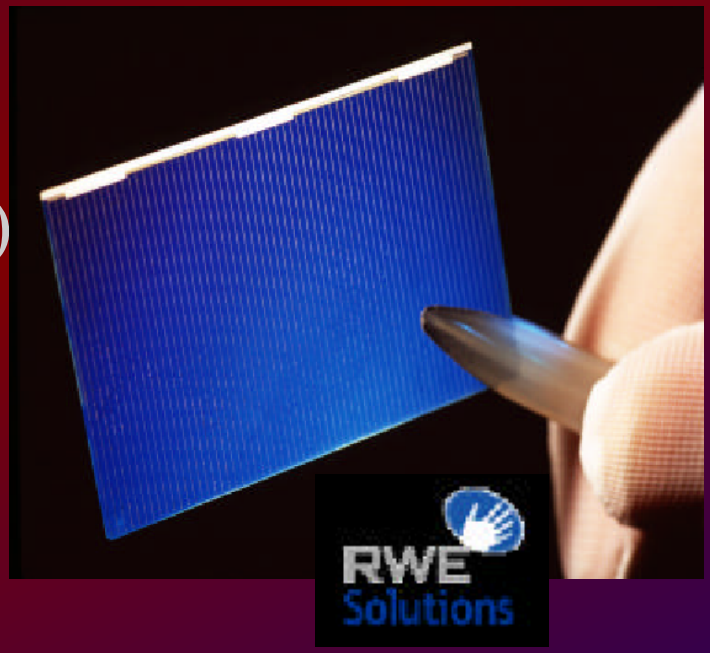
Main-Battery: Ni-Mh, 13 Ah capacity (P3-C was 7 Ah)
AUX-Battery: Ni-Cd, ~2-4 Ah capacity (P3-C was 4 Ah)

The Battery Charge Regulator (BCR) for P3-E is beeing designed and built at the University of Budapest.

Solar Generator

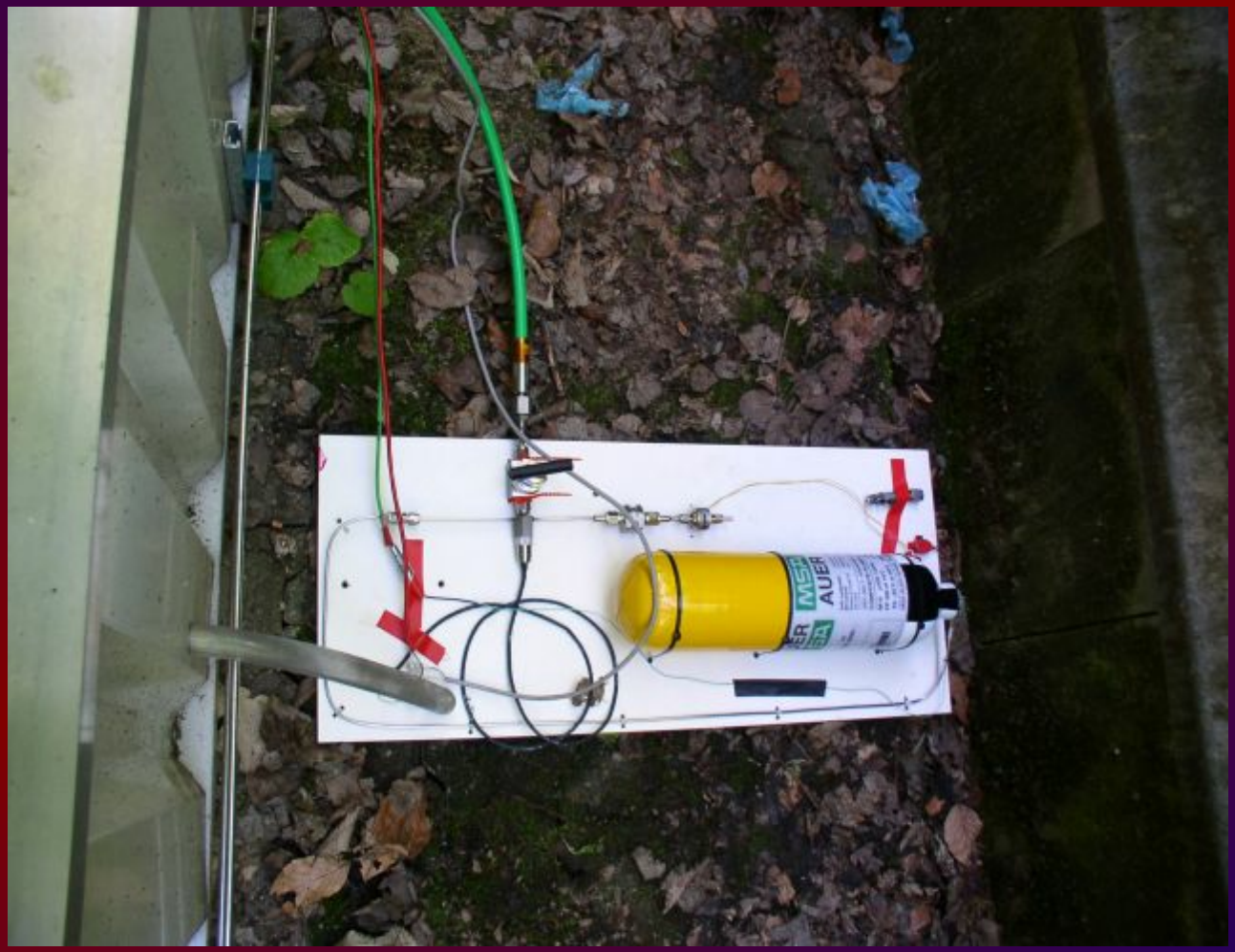
Solar Cells provided by RWE
for 2 panels of GaAs (~27% efficieny)
and 5 panels high efficiency
(~13%) Si cells.

AMSAT-UK donated £10,000
which will be used for the
assembly of the Solar Panels by
ASTRIUM (cover glasses, etc.)



Propulsion System

Propulsion System



AMSAT P3-E (Phase 3 Express)

Successful qualification of the Helium Tank:

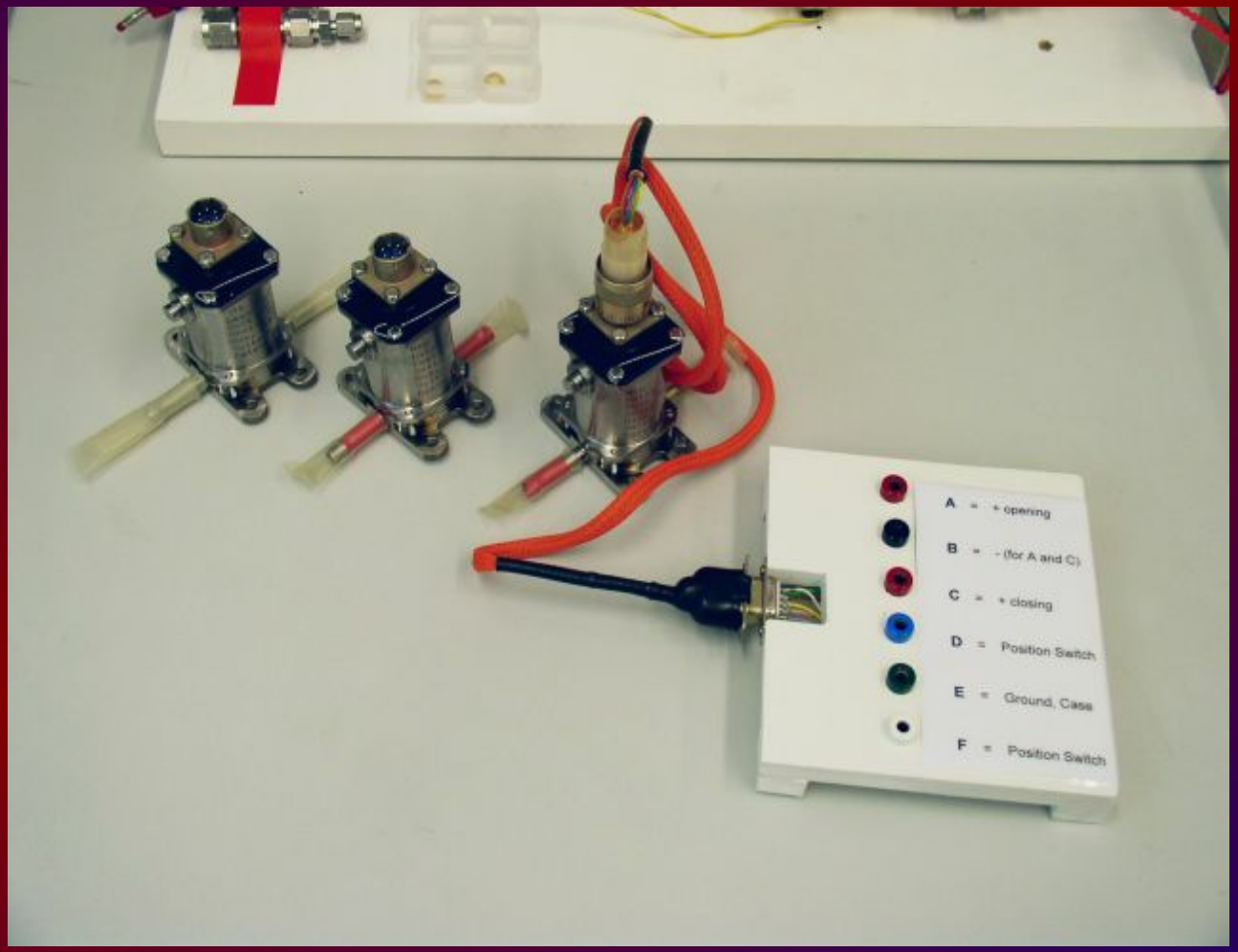
- Burst Test @ 1000 bar => No Degradation
- Destructive Burst @1160 bar => Margin Demonstration

Successful qualification of the High Pressure Section:

- Endurance Storage + Leakage @ 50 bar (3 Weeks)
- 2 complete Cycles Proof @ 600 bar with mit gas
- Endurance Storage + Leakage @ 400 bar (1 Week)

Propulsion System

Propulsion Flow Assembly (PFA)

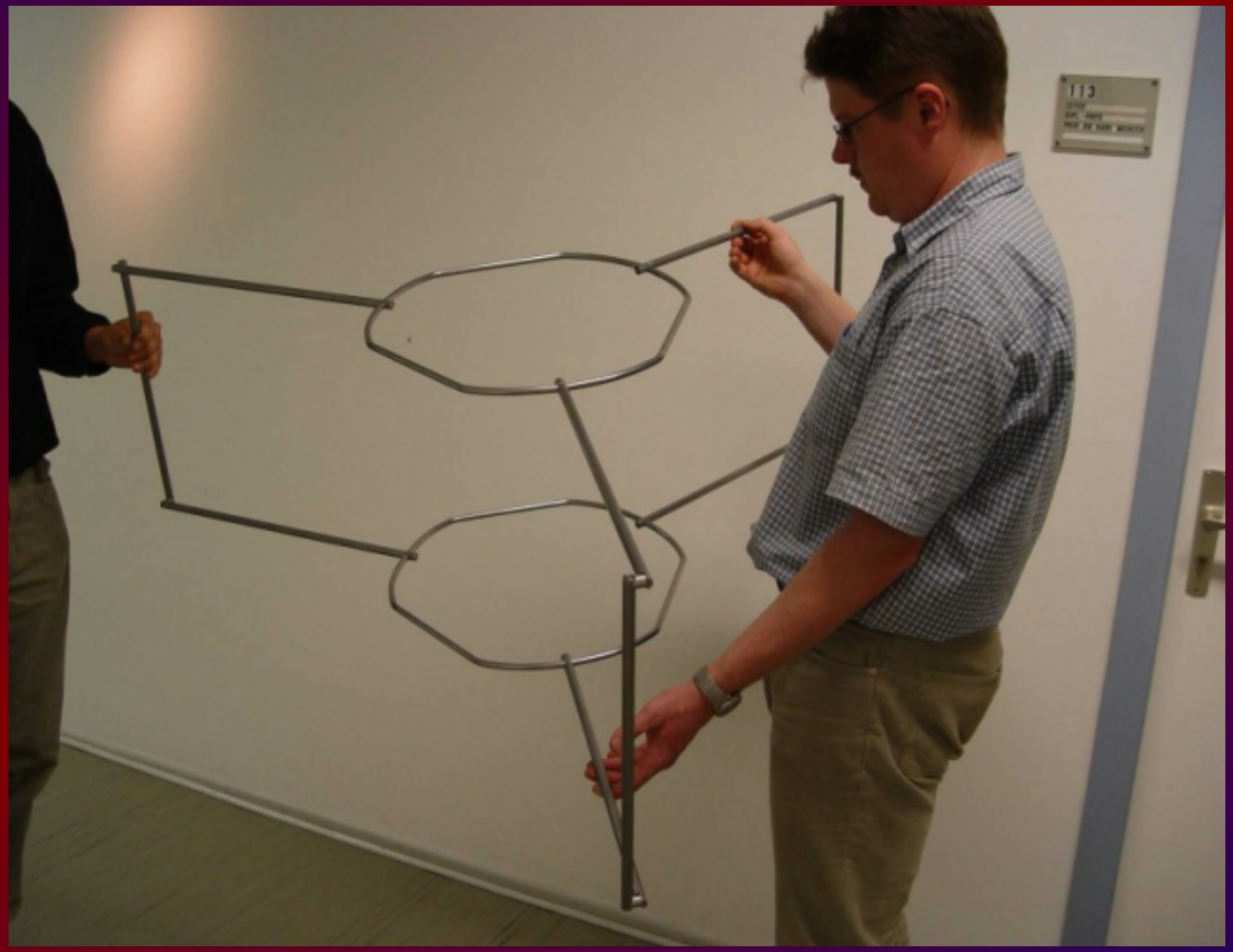


Propulsion System

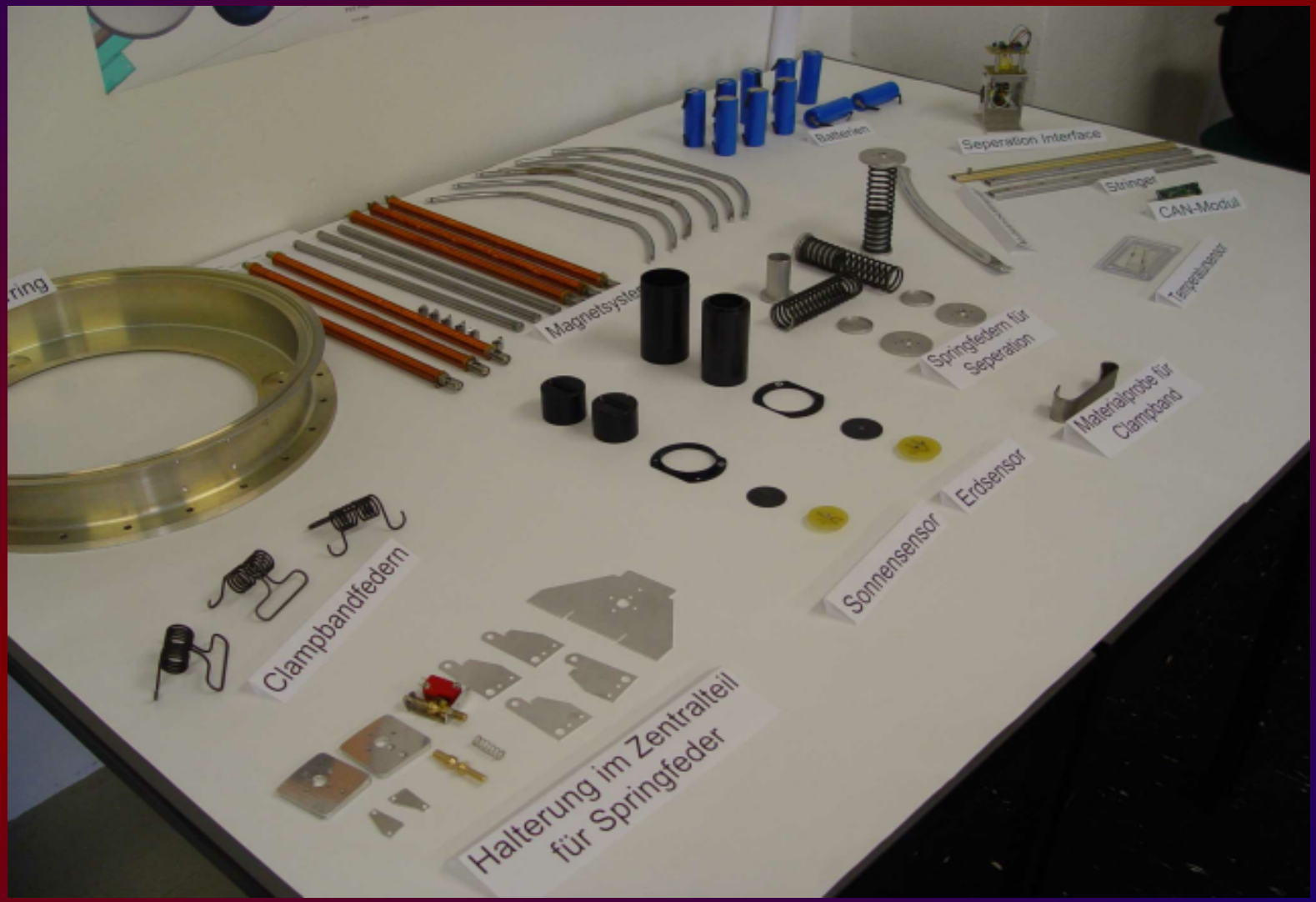
Fully satisfied Propulsion Team

Mounting for the 220 N motor

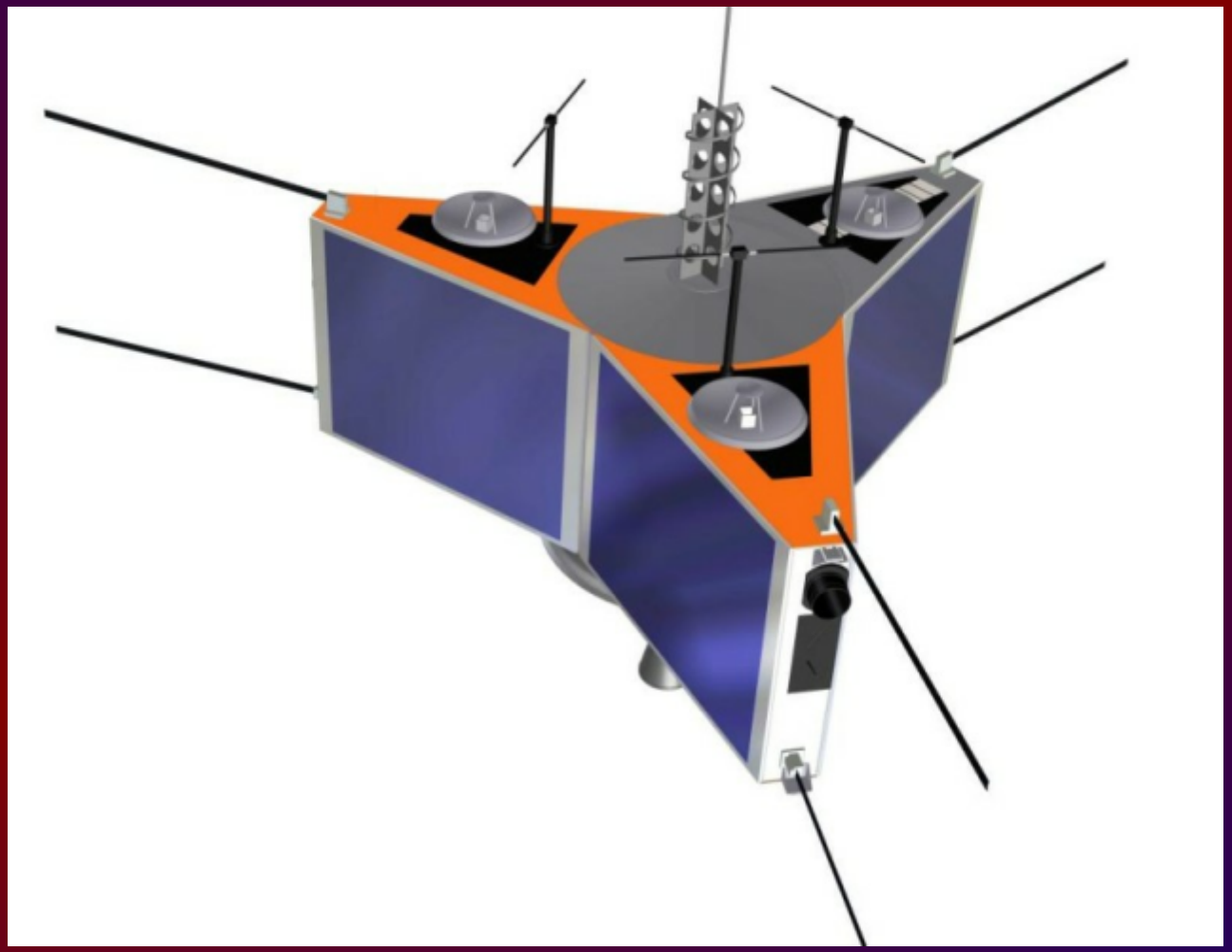
Magnet System



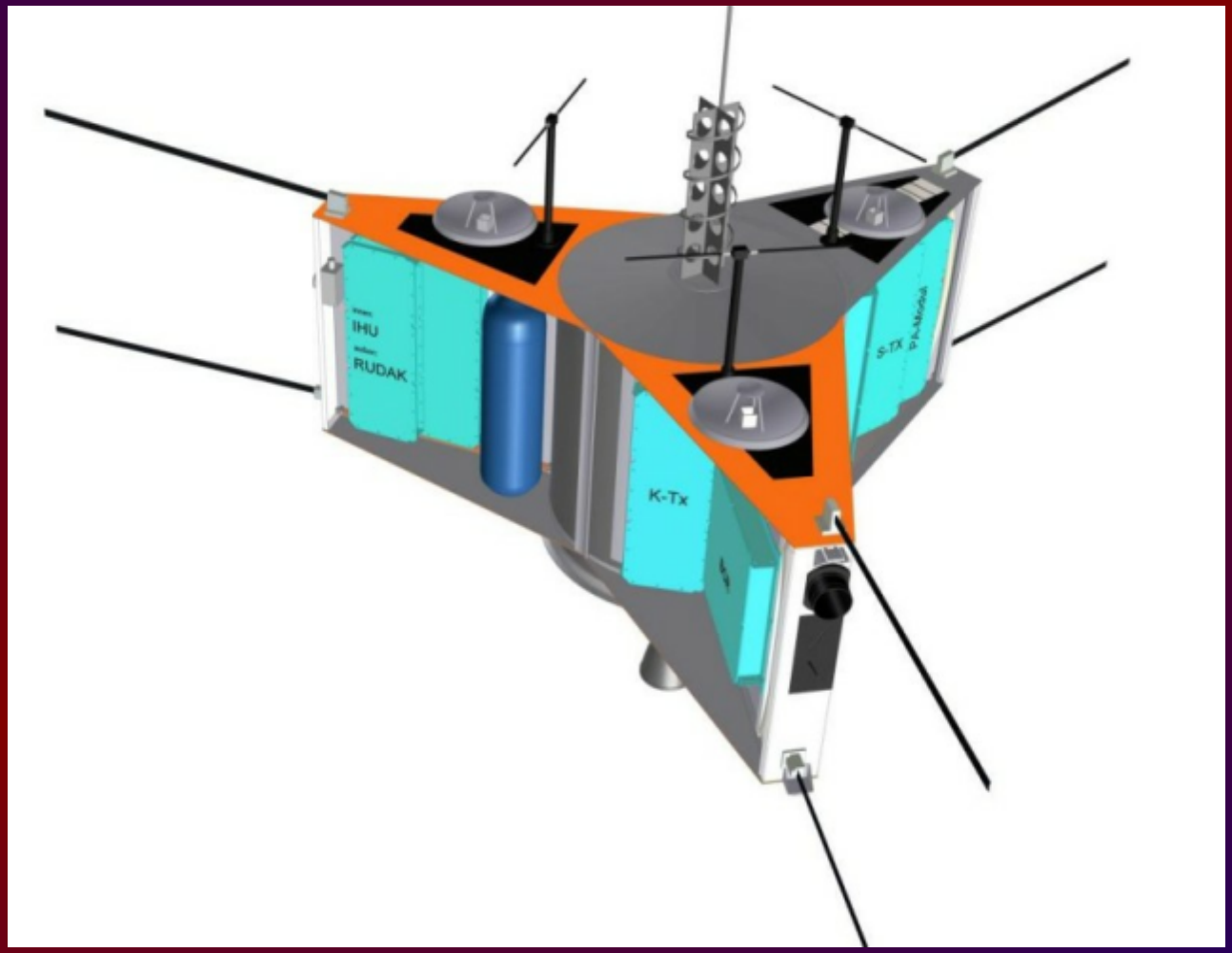
Misc...

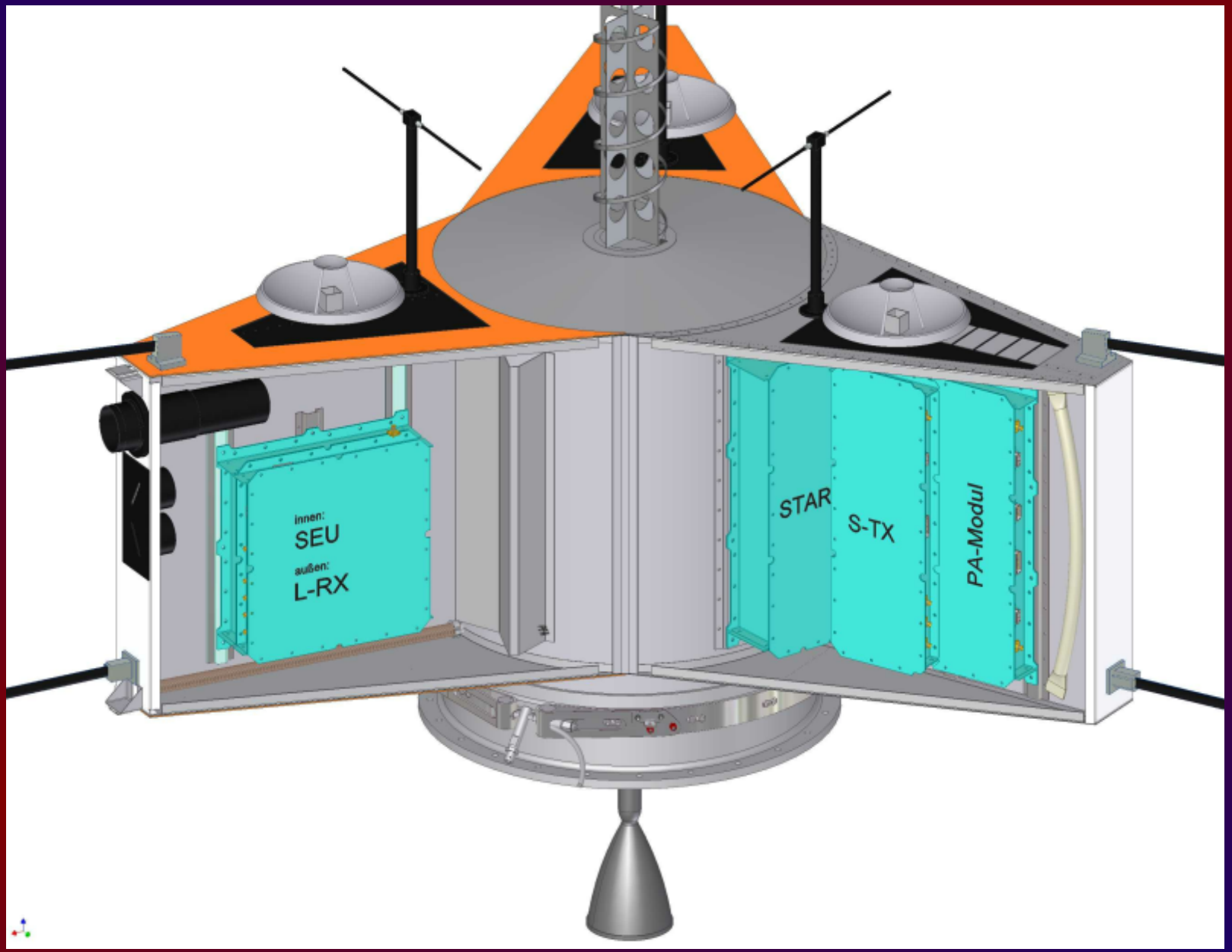

Batterien
Seperation Interface
Stringer
CAN-Modul
Temperatursensor
Magnetsyste
Springfedern für Seperation
Materialprobe für Clampband
Sonnensensor
Erdsensor
Clampbandfedern
Halterung im Zentralteil für Springfeder

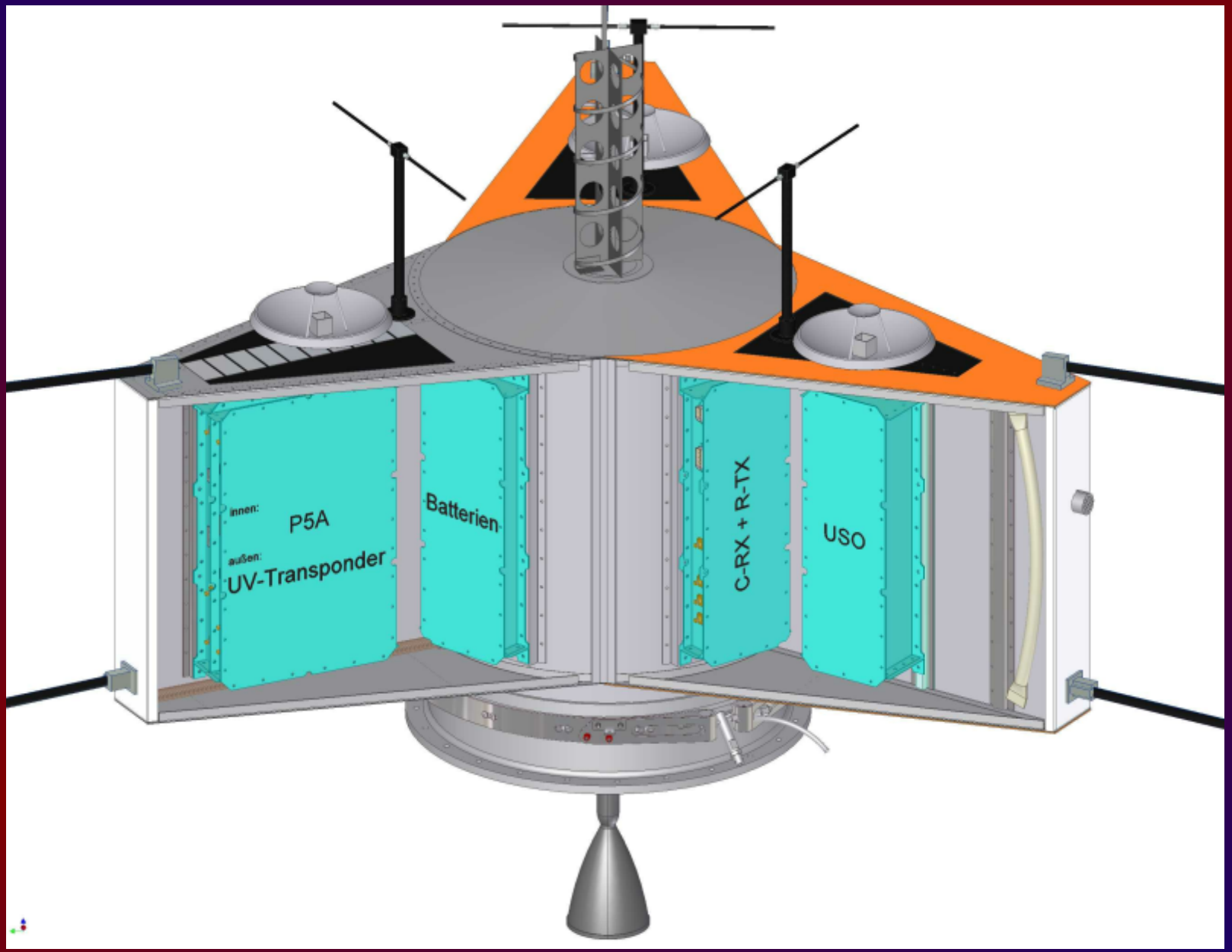
Antennas

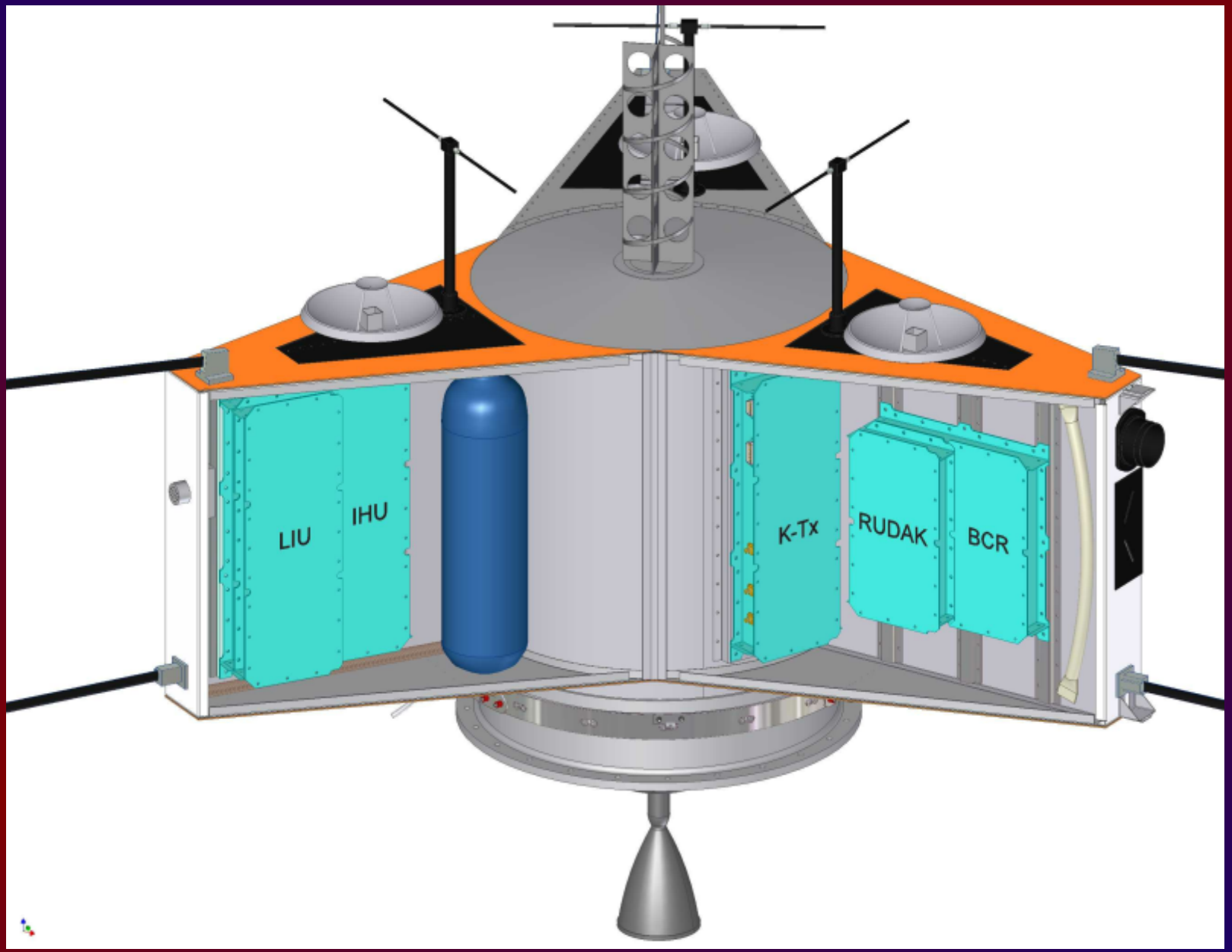


Modules

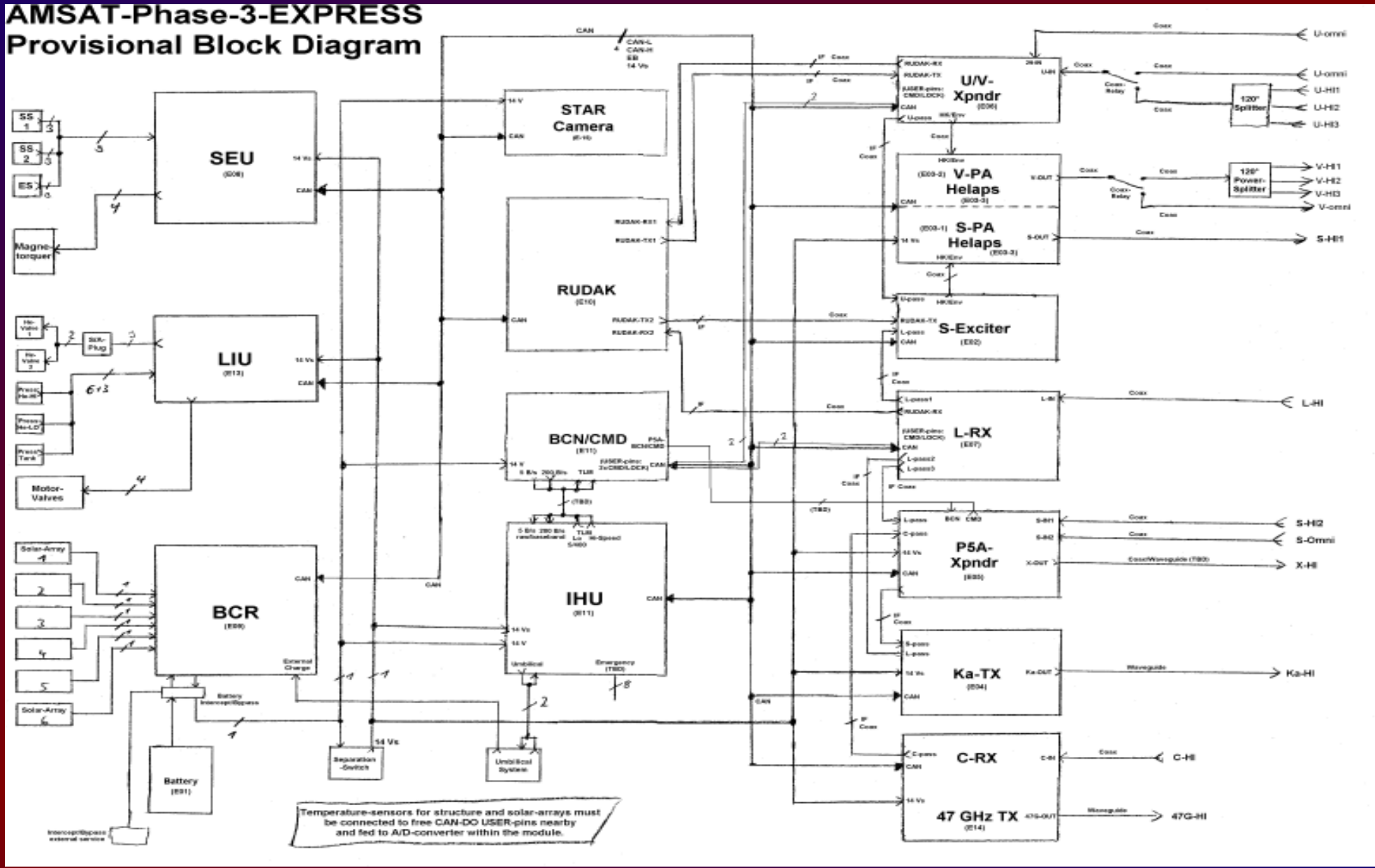



innen:
SEU
außen:
L-RX
STAR
S-TX
PA-Modul


innen:
P5A
außen:
UV-Transponder
Batterien
C-RX + R-TX
USO


LIU
IHU
K-Tx
RUDAK
BCR

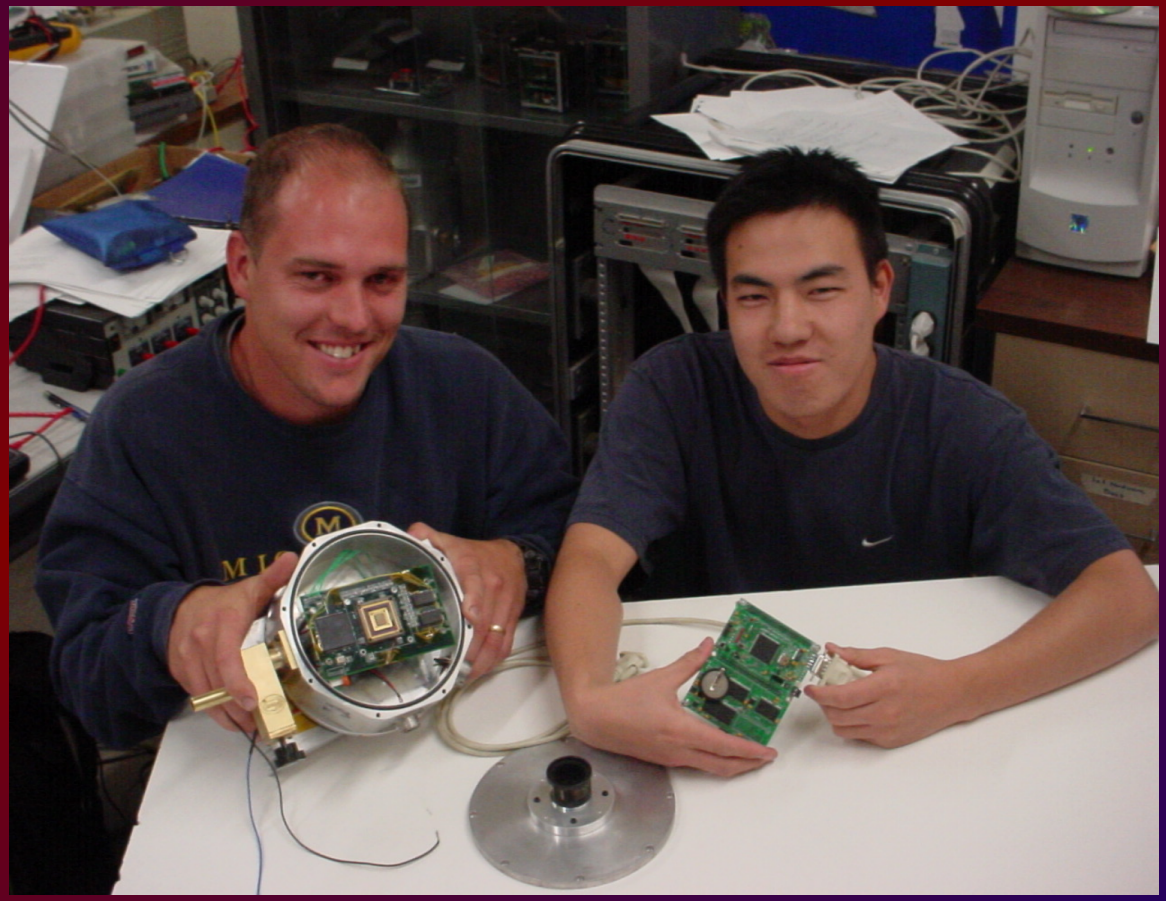
AMSAT-Phase-3-EXPRESS Provisional Block Diagram



Arizona Star

A Star Tracker for AMSAT P3-E and P5-A

STAR1000 sensor from Fillfactory University of Arizona linked to the IHU-3 via CAN-Bus



Fillfactory image sensors

imec

Transponder Payloads

- Mode UV (70cm Uplink, 2m Downlink)
- Mode US (70cm Uplink,. 13cm Downlink)
- Mode LS (23cm Uplink, 13cm Downlink)

- P5-A Transponder (X-Band transmitter)
- Ultra Stable Oscillator (USO)
- C-Rx and S-Rx
- 24 GHz, 47 GHz Beacons

RF meeting

L-band RX (Mirek Kasal, OK2AQK)

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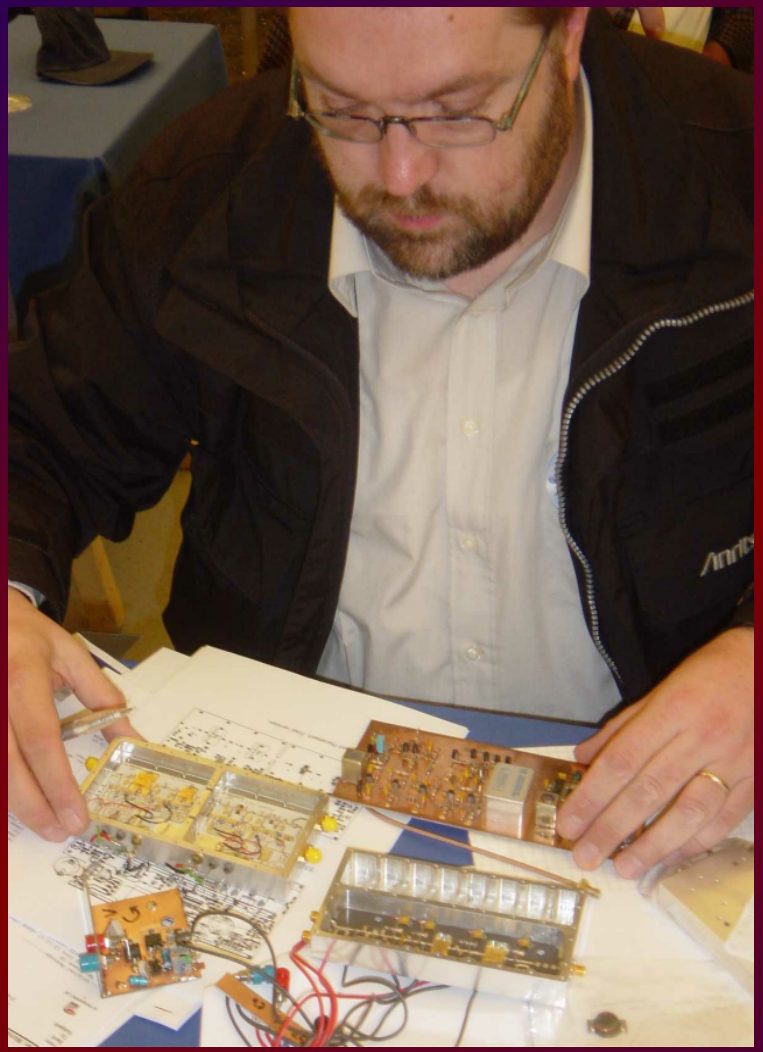
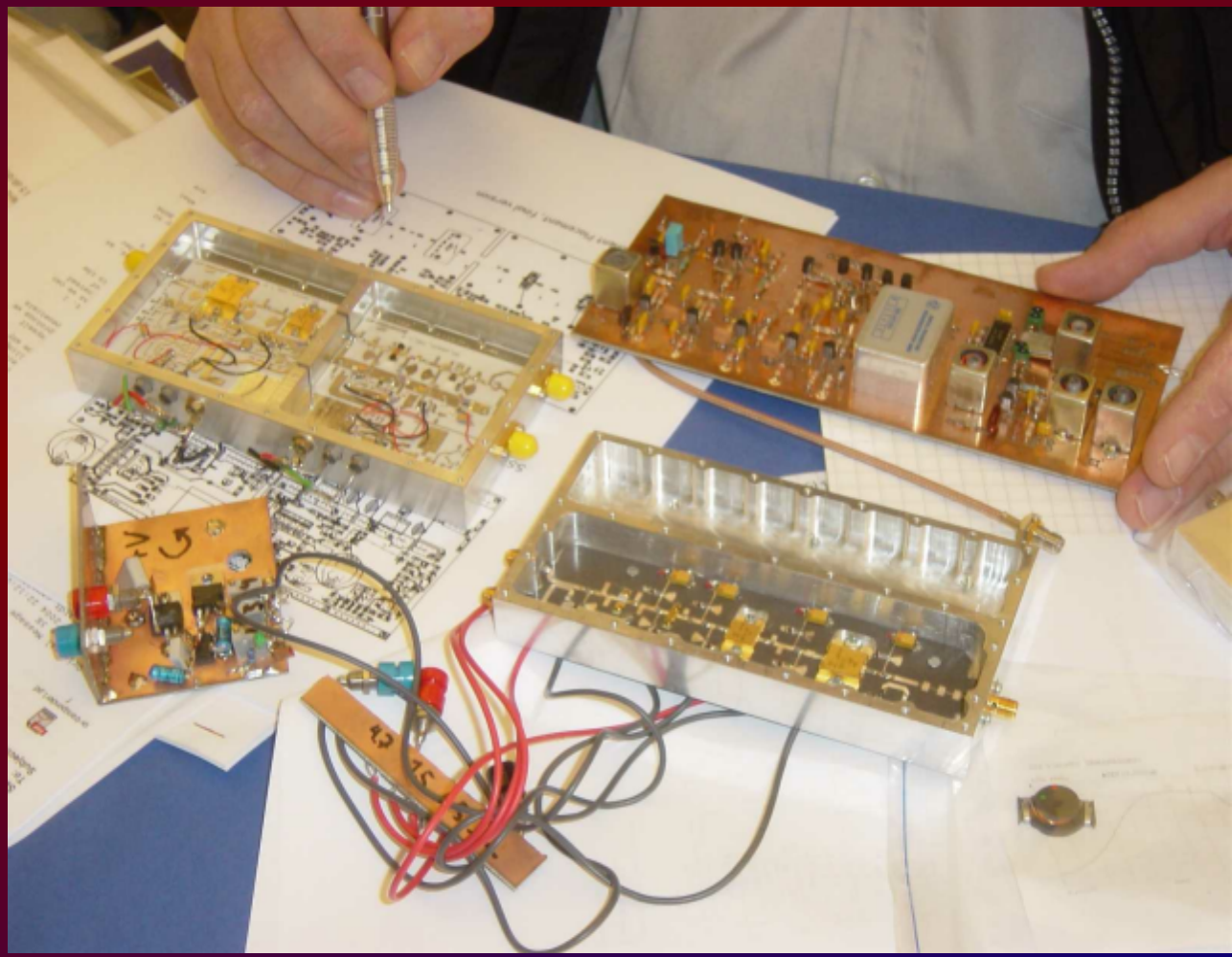
Satellites for Communication and Science
Satelliten für Kommunikation und Wissenschaft

X-Band TX & 29 MHz RX (Michael Fletcher OH2AUE)





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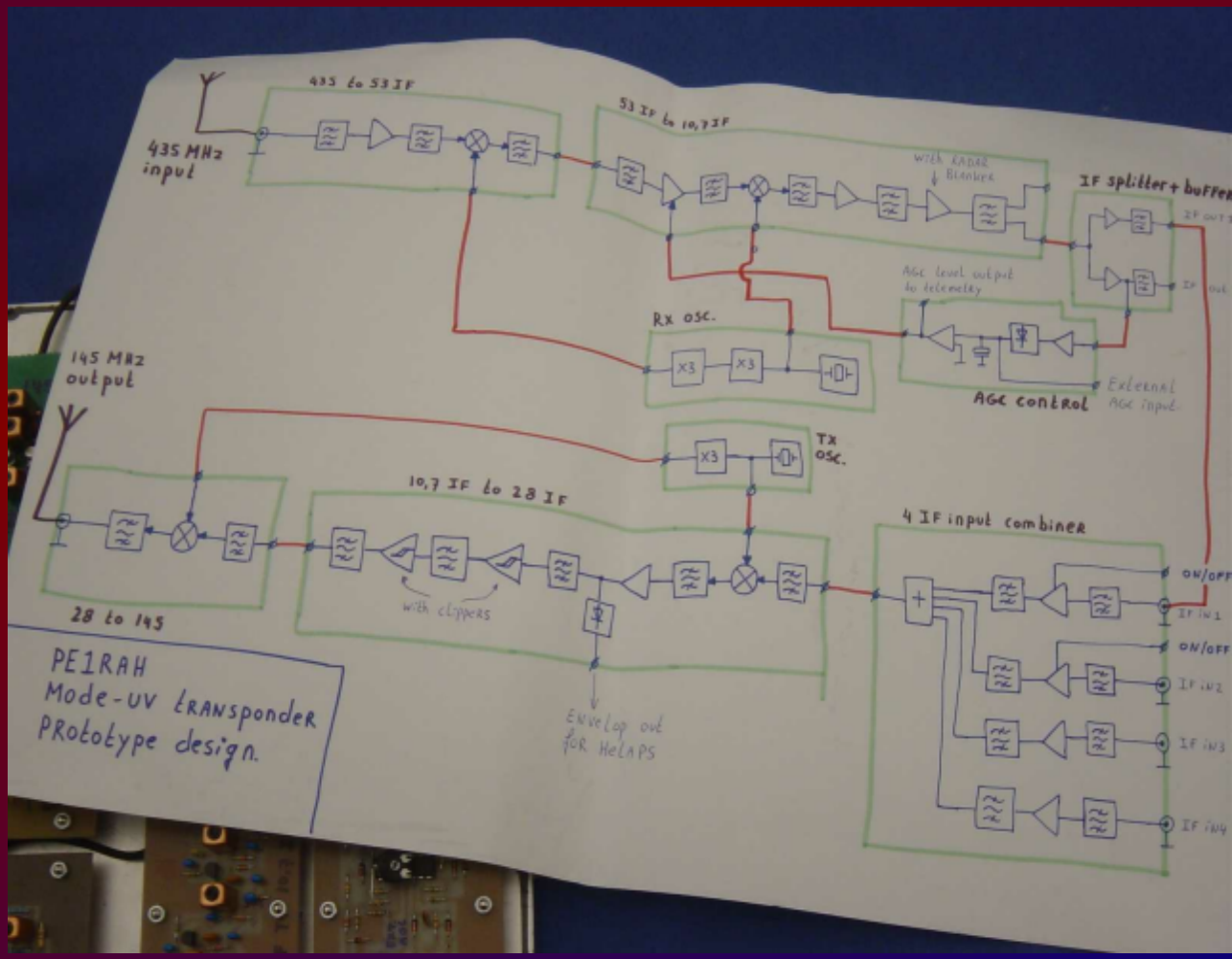
Satelliten für Kommunikation und Wissenschaft

Mode UV transponder prototype (William Leyenaar, PE1RAH)



QUESTION

What is critical to a high-technology space mission and yet is low technology?

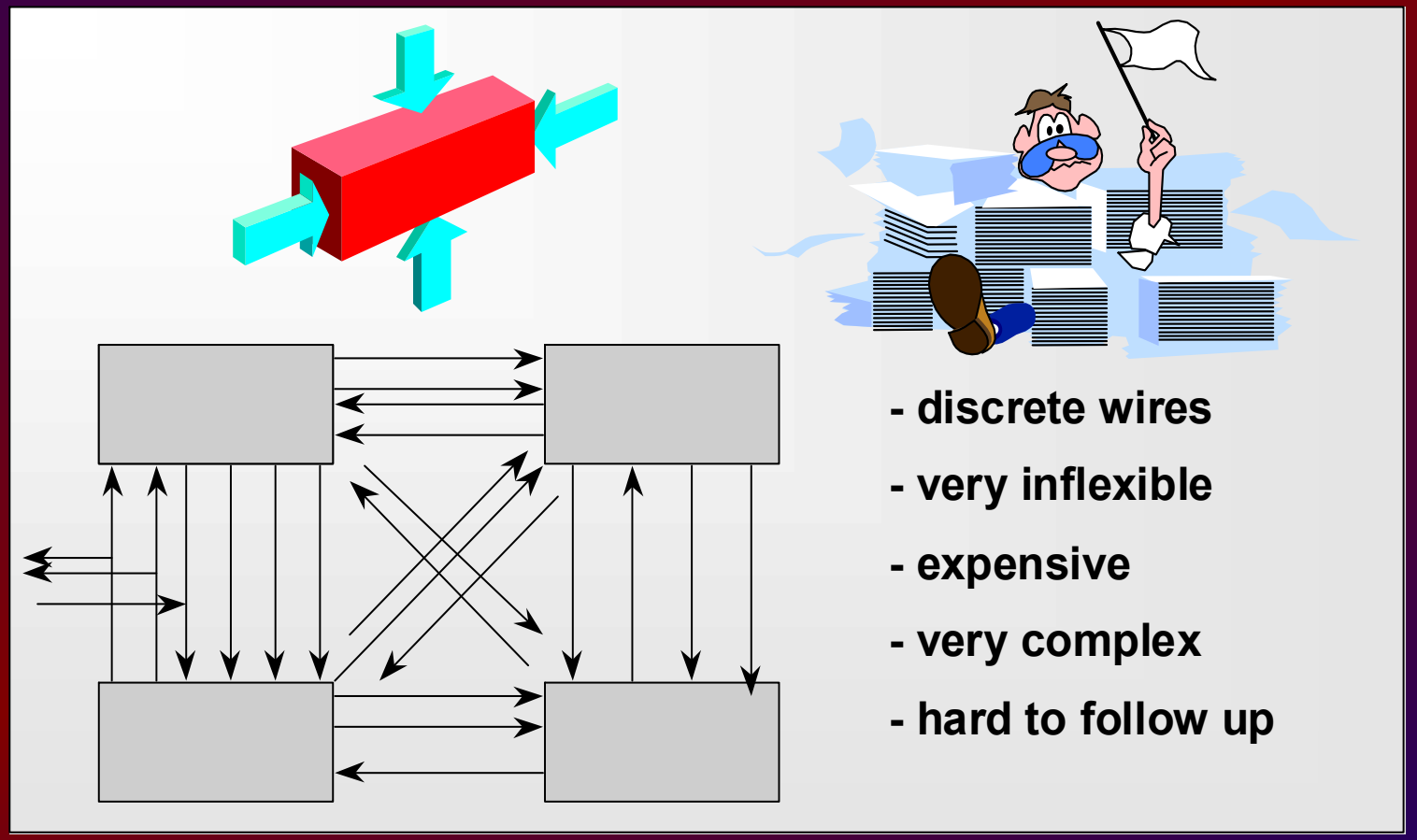
wait...

continued...

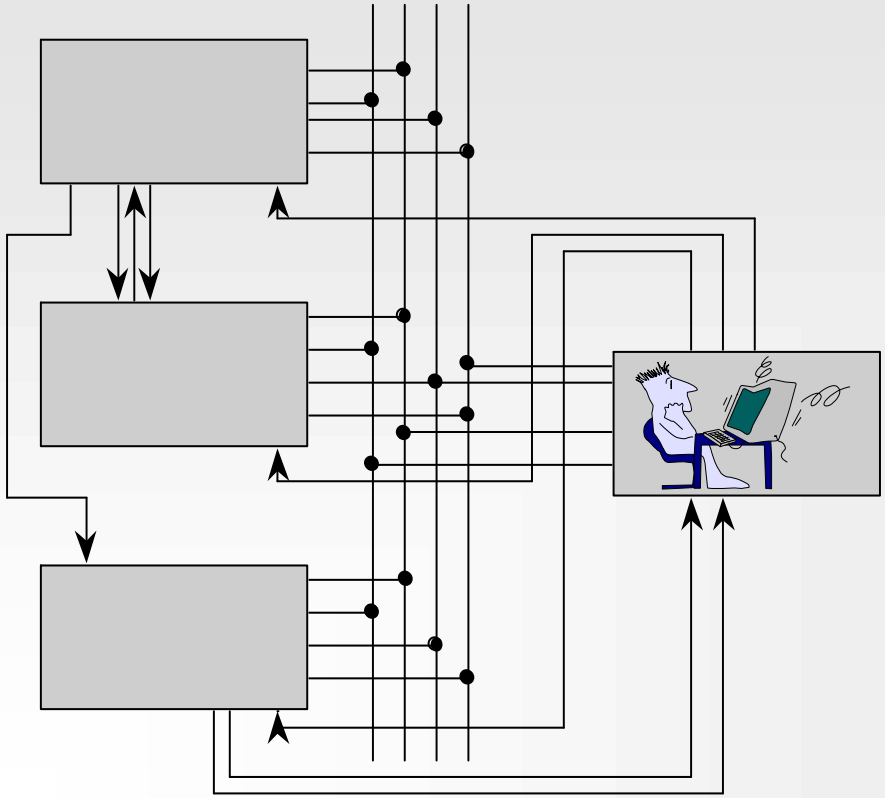
What task is one of the last to be defined, but must be delivered first?

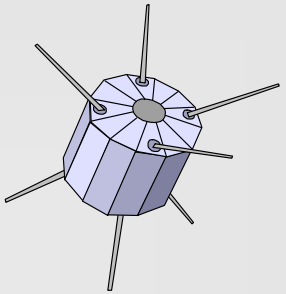
If you answered, „the cabling“, you are clearly an experienced spacecraft builder!!!

Discrete wiring



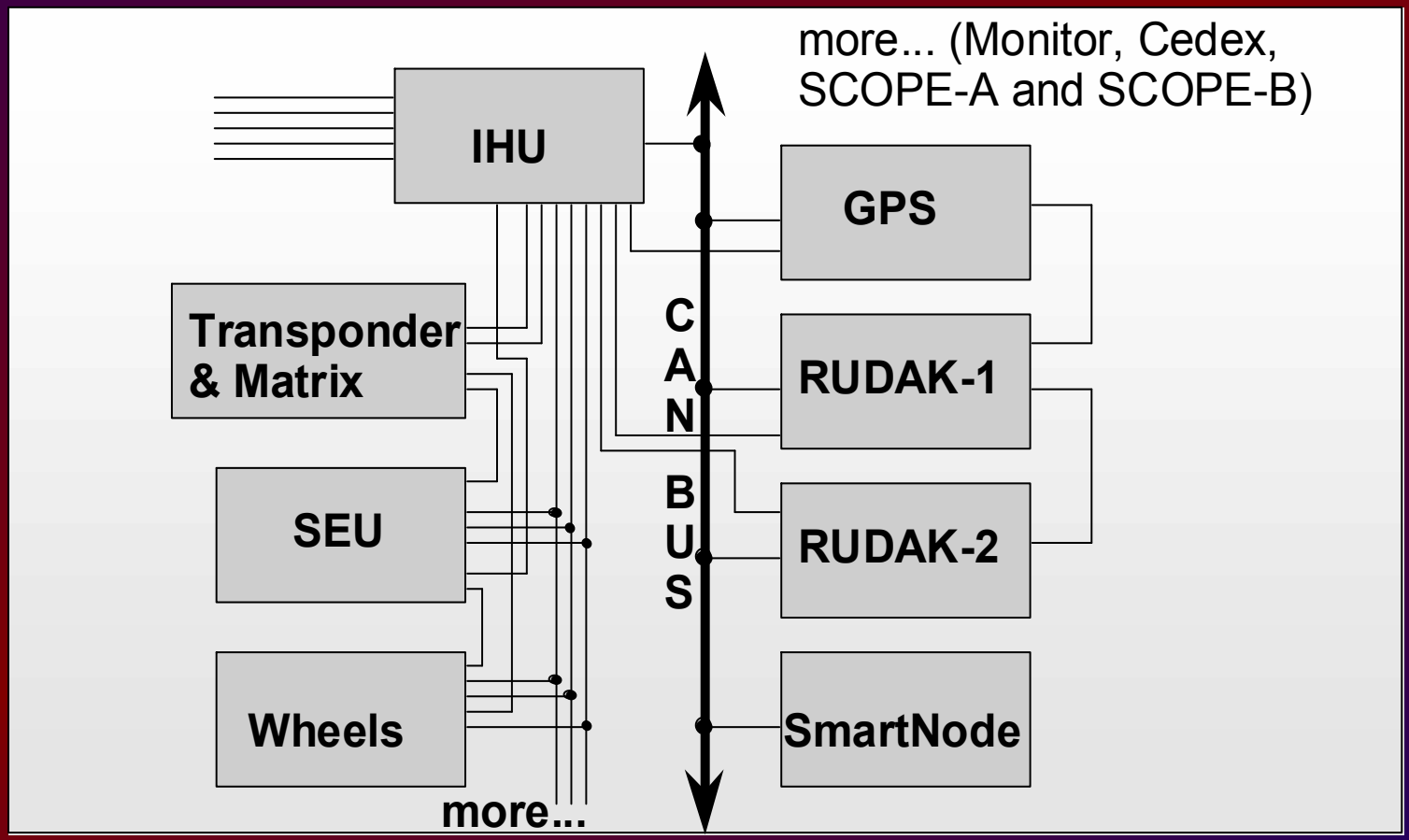
Multiplexing...





- Parallel Bus.
- Multiplexed Data with MUX Select.
- successfully flown on all P3-Satellites.
- good compromise between reliability and complexity.

Serial multiplexed bus (CAN-Bus)



CAN-DO

- Initial design idea: DB2OS

- Project iniated and sponsored by AMSAT-DL

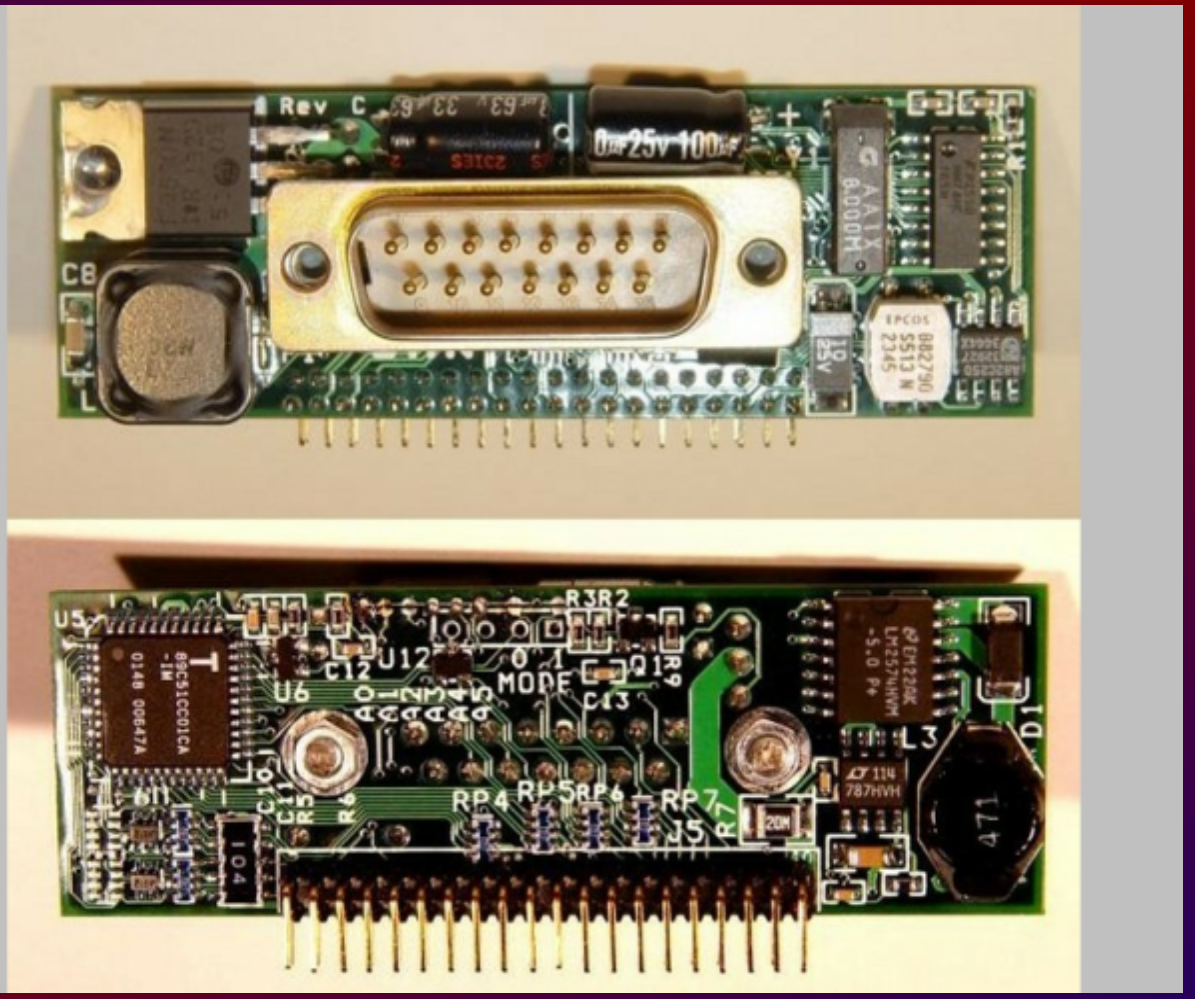
- CAN-DO Team: Bdale, Lyle, Chuck, Stephen, ...

- AMSAT-NA joined as co-sponsor

- 100 Units to be build for P3-E, P5-A and EAGLE

- hear more from Bdale later...

CAN-DO



IHU-3

- Turbo Code licensed by France Telecom to AMSAT-DL for non-commercial usage on P3-E and P5-A

- first prototype software implemented and must be ported to the IHU-3

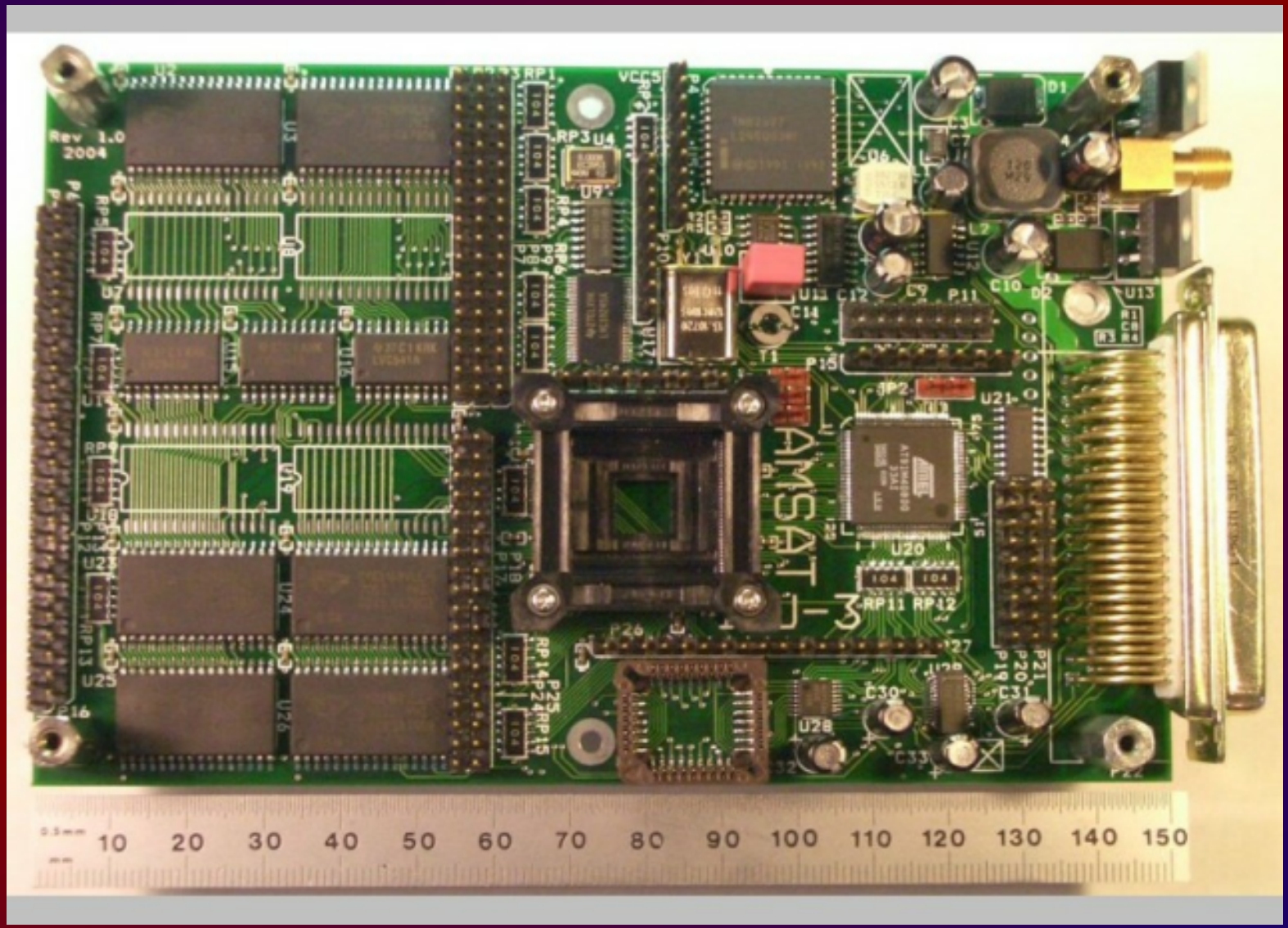
- ARM7TDMI-based CPU from ATMEL running IPS

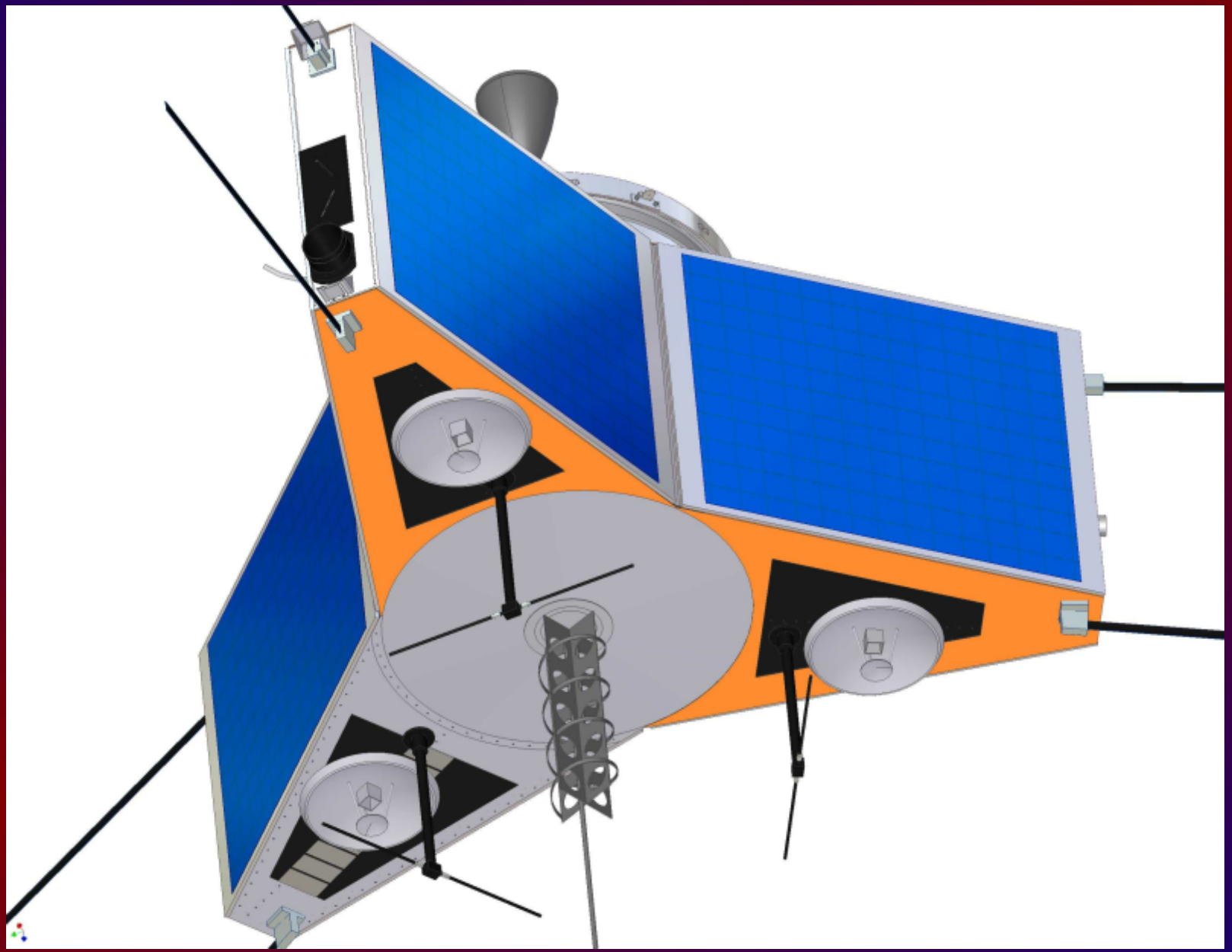
- reference design for P3-E and P5-A might be used on future missions (Eagle, P3-F)

IHU-3

- CAN-Bus Interface running at 800 Kbit/s
- Lo-Speed Telemetry (~ max. 400 Bit/s BPSK or 800 Bit/s NRZ)
- Hi-Speed Telemetry (~ max. 50...100 Kbit/s)
- Software FEC using Reed-Solomon, Viterbi and TurboCode
- 128 or 512 Kbyte EDAC RAM
- 8...16 MB RAM (no EDAC)
- 128 Kbyte FLASH
- ...

IHU-3


Rev 1.0
2004
AMSAT I-3
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150



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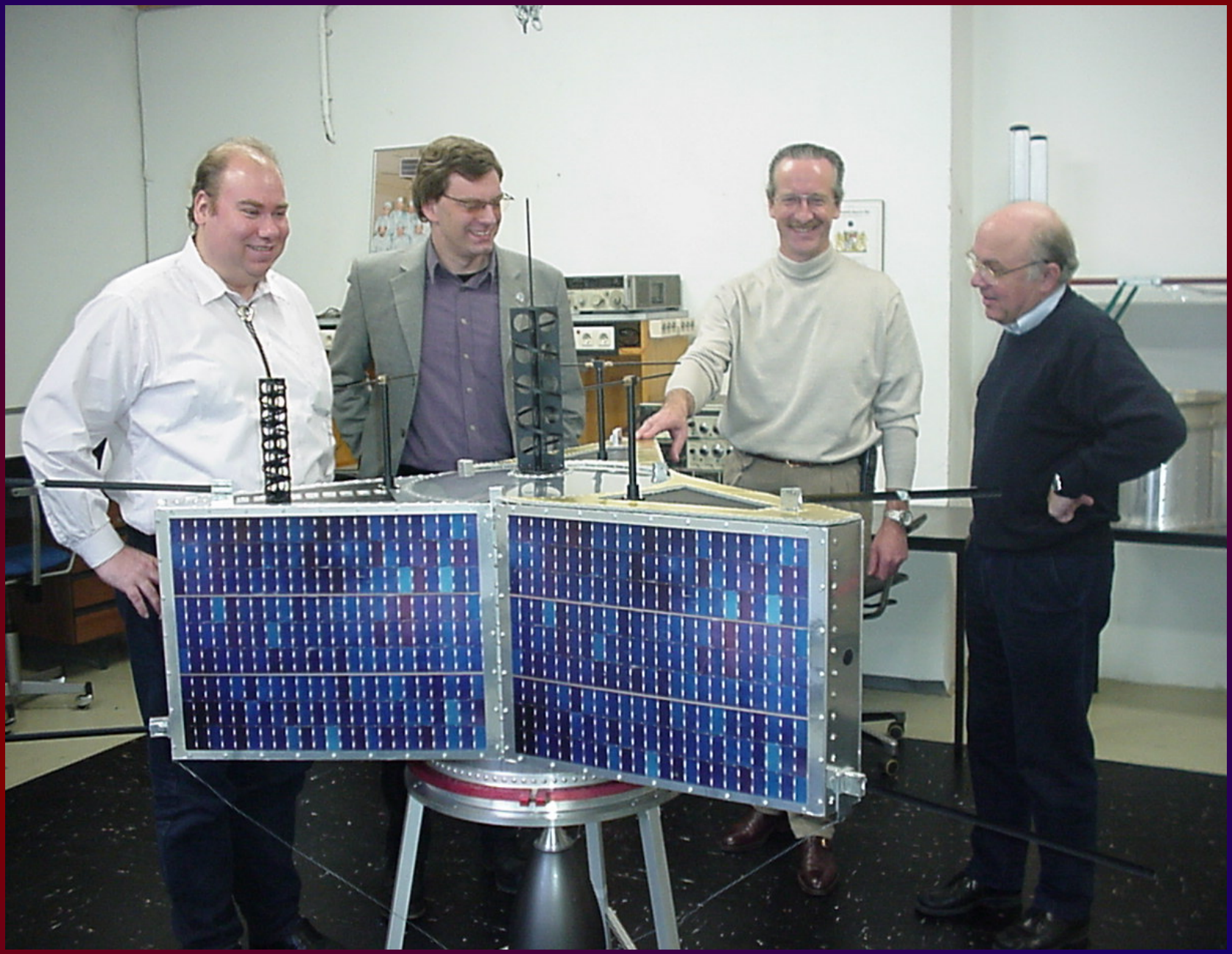
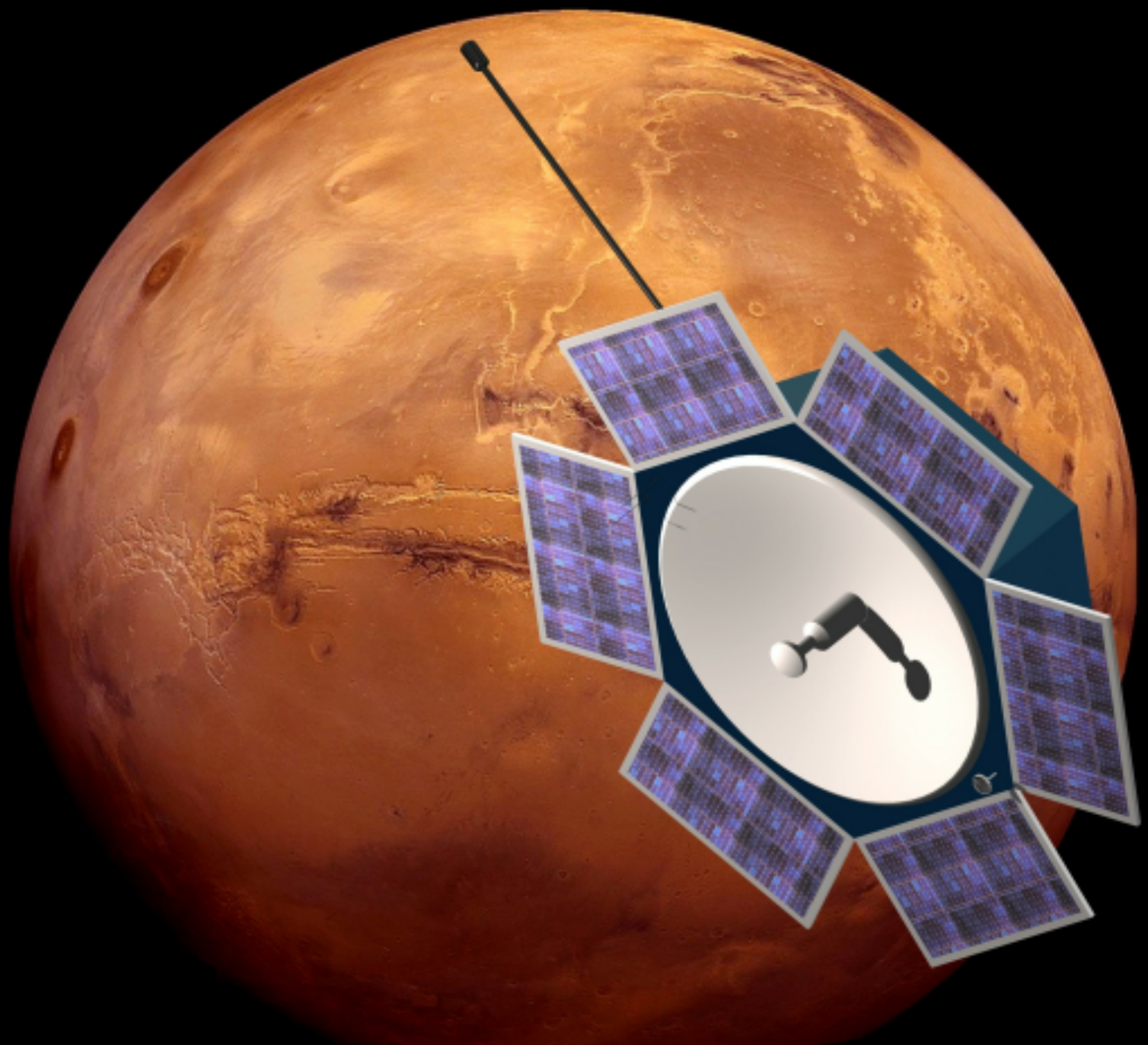


AMSAT-DL
International Satellites
for Communication
and Science

GO Mars

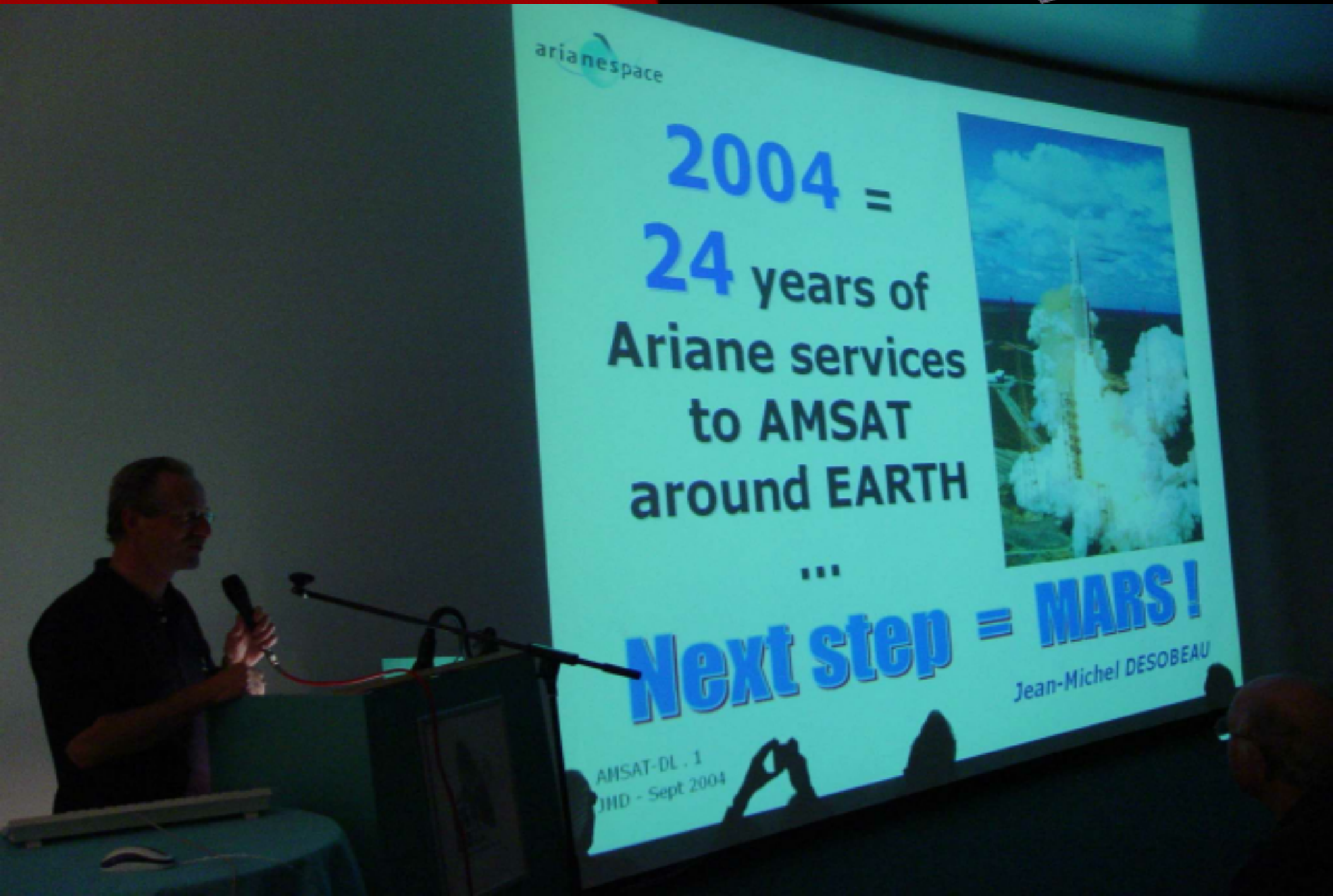
with AMSAT-DL's
P5A-Mission



AMSAT-DL
International Satellites
for Communication
and Science

GO Mars

with AMSAT-DL's
P5A-Mission

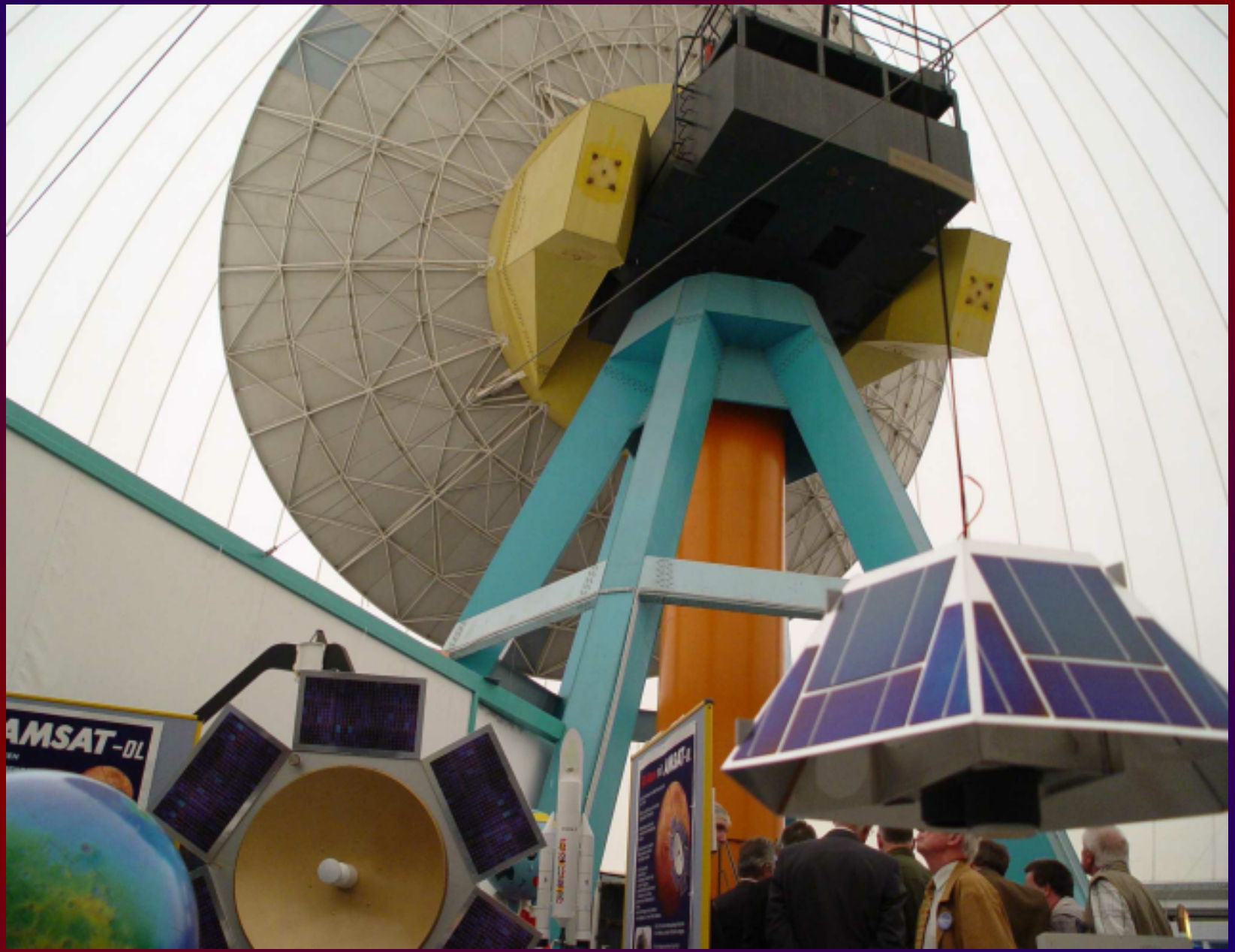


20m dish Bochum (P5-A)

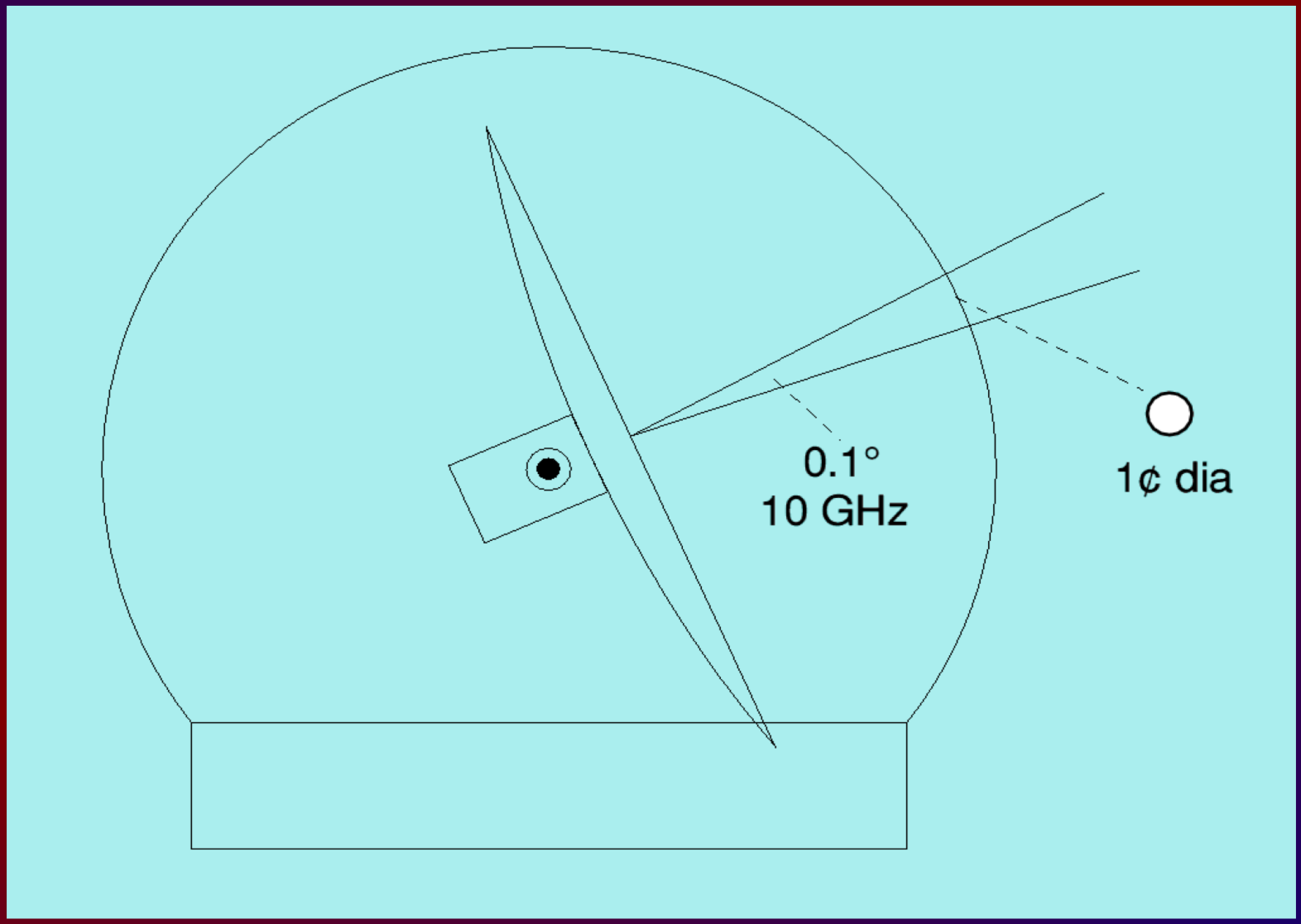
AMSAT-DL
International Satellites
for Communication
and Science

GO Mars

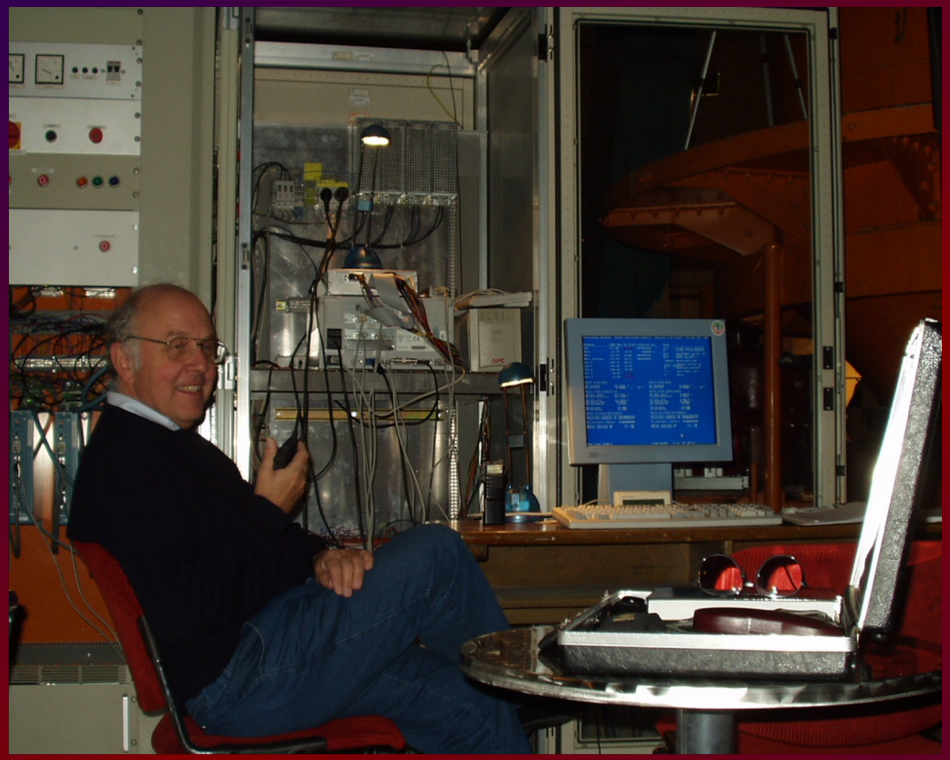
with AMSAT-DL's
P5A-Mission

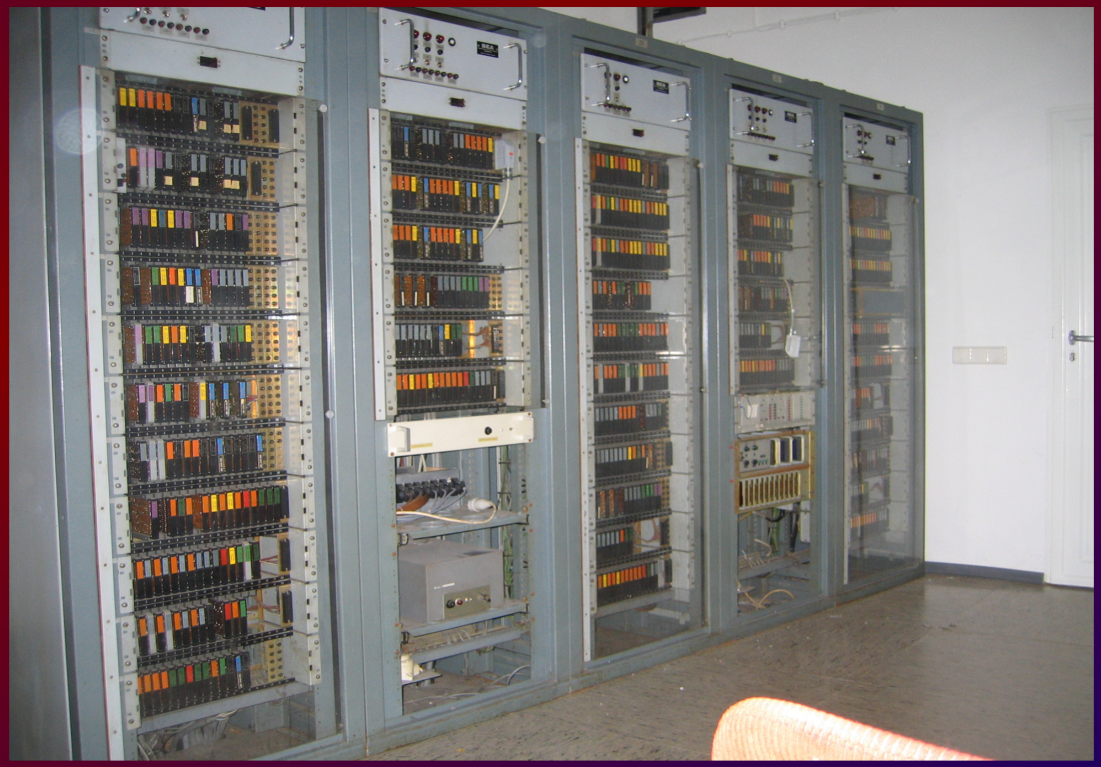


20m dish Bochum (P5-A)



20m dish Bochum (P5-A)

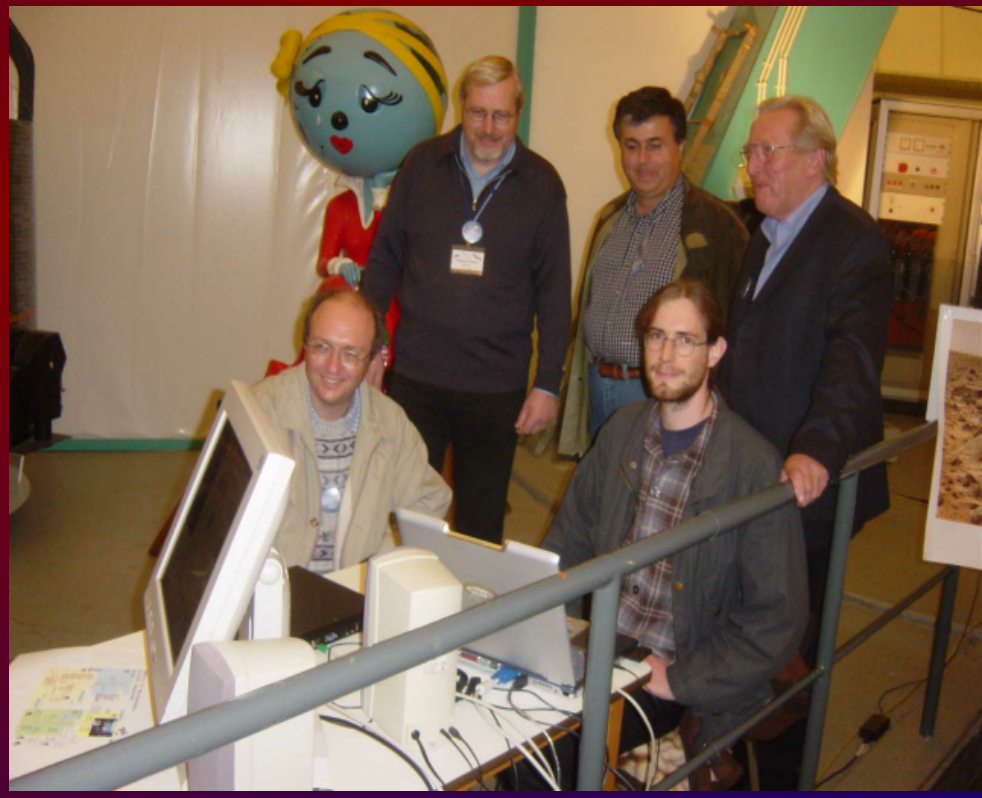




20m dish Bochum (P5-A)

30m dish Weilheim (DLR)

30m dish Weilheim (new SW & HW)



www.GO-Mars.org

www.AMSAT-DL.org